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P-GJPO-129

# Work Plan for the Bureau of Land Management Compound Characterization

## Monticello Mill Tailings Site

March 1993

Work performed under DOE Contract No. DE-AC04-86ID12584 for the U.S. Department of Energy
**Grand Junction Projects Office**

**RUST Geotech Inc.**

P-GJPO-129

#22

# Work Plan for the Bureau of Land Management Compound Characterization

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## 1.0 INTRODUCTION

This document describes the rationale and objectives for performing characterization work on land formerly owned by the U.S. Bureau of Land Management (BLM) at the Monticello Mill Tailings Site (MMTS) in Monticello, Utah. The U.S. Department of Energy (DOE), under the authority of the Atomic Energy Act, initiated the Surplus Facilities Management Program (SFMP) in 1978 to ensure safe caretaking and decommissioning of government facilities that were retired from service but still radioactively contaminated. In 1980, the millsite was accepted into the SFMP. The MMTS was listed on the National Priorities List in November 1989. RUST Geotech Inc. (Geotech), operating contractor for the DOE Grand Junction Projects Office, is conducting the remediation to restore the millsite and peripheral properties to acceptable levels of radioactivity.

The Work Plan for the Bureau of Land Management Compound Characterization specifies sampling and analytical procedures, data and document management, and data evaluation and interpretation. It establishes quality assurance guidelines to ensure that all samples are representative of their original environment and that methods of sample collection and analysis result in defensible and comparable data of known accuracy and precision. All activities will be performed according to the *Monticello Mill Tailings Site Health and Safety Plan* (in progress), the *Monticello Mill Tailings Site Bureau of Land Management Compound Characterization Sampling and Analysis Plan* (in progress), and the *Monticello Mill Tailings Site Operable Units I, II, and III, Quality Assurance Program Plan* (Chem-Nuclear Geotech, Inc. 1992). Provisions described in *Test Methods for Evaluating Solid Waste* (U.S. Environmental Protection Agency 1990) were followed in the preparation of this Work Plan.

## 2.0 SITE BACKGROUND

The Monticello millsite is a 78-acre tract located along Montezuma Creek, south of the city of Monticello, San Juan County, Utah. The mill operated between 1942 and 1946 producing vanadium and uranium-vanadium sludges. In 1948 the mill was purchased by the U.S. Atomic Energy Commission (AEC) and uranium milling continued to January 1960, when the mill was permanently closed. Part of the land was transferred to the BLM after the mill closed. The BLM used several buildings enclosed by a fence for offices, equipment and herbicide storage, electrical and carpentry shops, and vehicle maintenance (Figure 2-1). This area is referred to as the "BLM Compound." In 1990, the BLM land became the property of the DOE. Other than for BLM use, the BLM Compound has remained under the control of the AEC and its successor agencies, the U.S. Energy Research and Development Administration and the DOE.

The radioactive and nonradioactive properties of the tailings existing at the site reflect the various processing technologies used during the operation of the mill (UNC Geotech 1990a). During mill operations and subsequent use of portions of the land by the BLM, a variety of activities may have occurred which may have contaminated the soil with compounds that appear on the Superfund Contract Laboratory Program Target Compound List (TCL). These activities include discharge of maintenance shop wastes, spills from herbicide storage and use, leaks or spills from fuel storage tanks, and leaks from underground lines leading from fuel storage tanks to dispenser islands.

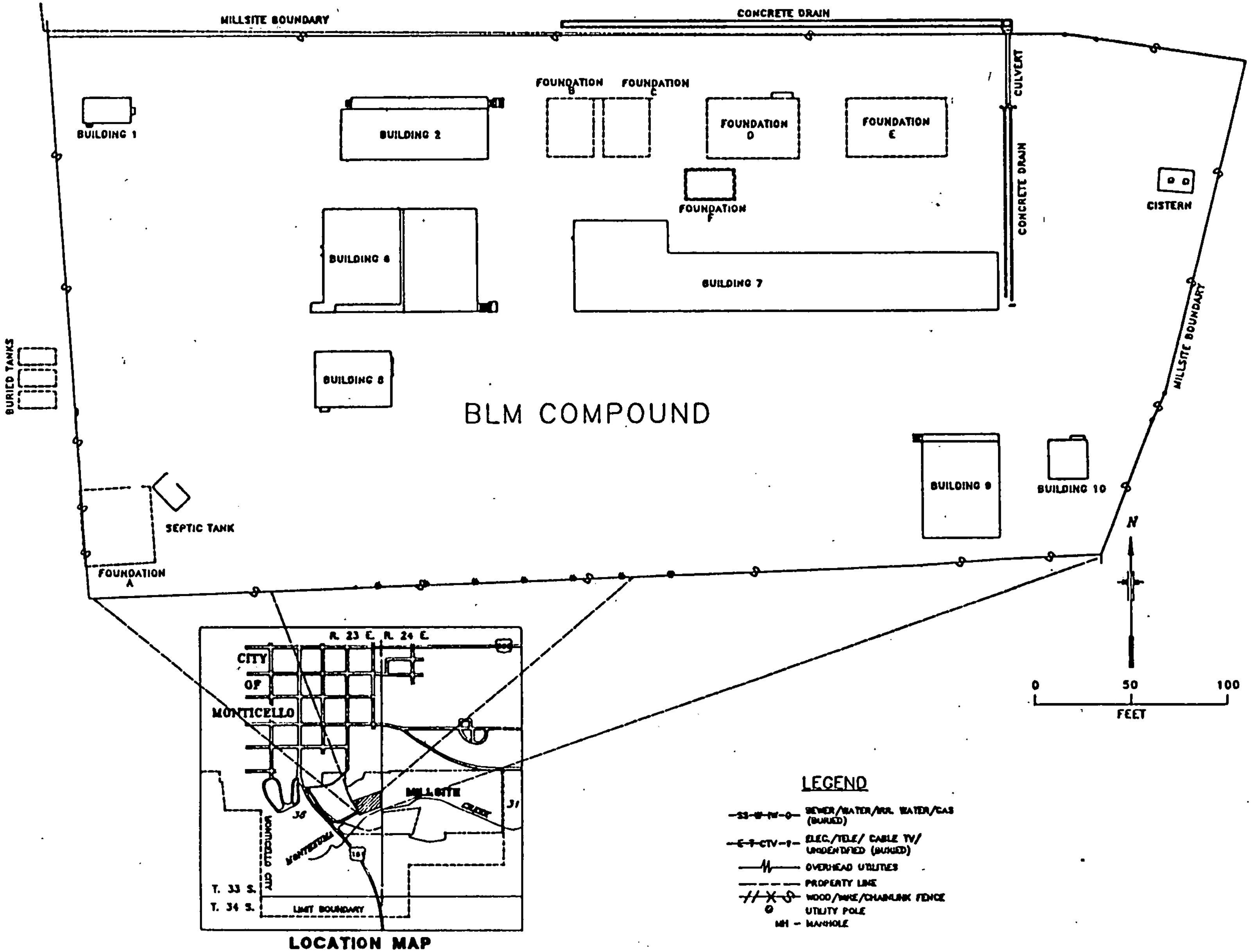


Figure 2-1. The BLM Compound, Monticello, Utah

## 2.1 Previous Investigations

### 2.1.1 BLM Site Walk-Through on June 28, 1989

A BLM site walk-through was conducted on June 28, 1989, to identify items, in part, that may pose an environmental concern. The observations made were

- Minor paint or petroleum spills are visible in Buildings 1, 6, and 8.
- Laboratory supplies are stored in Building 7.
- Asbestos insulation may exist on pipe and in vinyl asbestos tile in the flooring in Buildings 2 and 6; vinyl asbestos tile may also exist on concrete at Foundation A.
- Underground storage tanks (USTs) may exist near Foundation E and near Buildings 2 and 6.
- Four 55-gallon and two 30-gallon drums are stored under Building 2 and four 55-gallon drums and one 30-gallon drum are stored on a concrete cistern at the east end of the compound.
- A battery storage area exists outside of the southwest corner of Building 7.
- Floor drains are present in Foundations B, C, D, and E.

The follow-up action to this walk-through was a sampling survey of the compound and an area to the west of the compound fence where three USTs are located. Samples were collected September 12 - 17, 1989. A summary of the findings follows:

- At Buildings 1, 6, and 8, no organic vapors were detected by an organic vapor detector in the air space above the paint or petroleum spills; it was determined there was not sufficient cause to collect samples for volatile organic analysis. Two soil samples were collected outside of Building 6 to determine the concentration of the eight metals specified in the extraction procedure (EP) toxicity characteristic (40 CFR 261.24). These metals are arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. No EP-toxicity metals were detected.
- The laboratory supplies stored in Building 7 were disposed of by Stone and Webster, a firm contracted by the DOE for this purpose.
- Analysis of samples collected from Buildings 2 and 6 and Foundation A confirmed the presence of asbestos. These analytical results are summarized in Table 2-1.
- Two soil borings were drilled near Building 2 and one soil boring was drilled near Building 6 in the areas where USTs were suspected. No organic vapors were detected by an organic vapor detector and analyses of samples collected detected no EP-toxicity metals. One soil boring was drilled near the suspected UST south of Foundation E. The organic vapor detector detected organic vapors at 1 part per million (ppm). Analysis of the soil sample collected indicated that no EP-toxicity metals were present above their detection limits. (See discussion in Section 2.1.4.)

**Table 2-1. Analytical Results from Asbestos Sampling at Buildings 2 and 6 and Foundation A**

| Building/ Foundation | Sample Type | Analytical Result |
|---|---|---|
| 2 | Surface Soil Sample | less than 1-volume % chrysotile |
| 2 | Surface Soil Sample | 4-volume % chrysotile |
| 2 | Pipe Insulation | 51-volume % chrysotile |
| 2 | Floor Tile | 5-volume % chrysotile |
| 2 | Floor Tile Glue | 2 % estimated chrysotile |
| 2 | Floor Panel | 19-volume % chrysotile |
| 6 | Pipe Insulation | 50-volume % amosite; 2-volume % chrysotile |
| 6 | Floor Tile | 3-volume % chrysotile |
| 6 | Floor Tile Glue | 9 % estimated chrysotile |
| A | Floor Tile | 4-volume % chrysotile |
| A | Floor Tile Glue | 6 % estimated chrysotile |

- The drums in the crawl space under Building 2 and two of the four 55-gallon drums and the one 30-gallon drum on the cistern were empty and showed no evidence of leaks; therefore, the drums were not sampled.

  Liquid from one drum on the cistern (Drum 1) was sampled (sample identification number MLA589) for semi volatile organic compounds (semi-VOCs). Several tentatively identified compounds were detected and their concentrations estimated. Liquid from another drum on the cistern (Drum 2) was also sampled (sample identification number MLA590) for semi-VOCs. Naphthalene and 2-methylnaphthalene were detected in addition to several tentatively identified compounds. These analytical results are summarized in Appendix A. A sample collected from the liquid in the cistern was submitted for analysis of EP-toxicity metals. No EP-toxicity metals were detected above their respective detection limits.

- Soil around the batteries stored outside of the southwest corner of Building 7 and around batteries found on the outside northwest corner of Building 10 were sampled for EP-toxicity metals and pH. No EP-toxicity metals were detected; the soils outside of the southwest corner of Building 7 and outside of the northwest corner of Building 10 had pH values of 8.0 and 7.9, respectively, and therefore do not exhibit the characteristic of corrosivity.

- No organic vapors were detected by an organic vapor detector in the floor drains at Foundations B, D, and E. The organic vapor detector measured organic vapors at 13 ppm in the floor drain at Foundation C. Volatile organic compound (VOC) analysis of a soil sample collected (sample identification number MLA533) from this drain reported 1,2-dichloroethane (1,2-DCA), trichloroethene (TCE), tetrachloroethene (PCE), and ethylbenzene. Analytical results for sample MLA533 are summarized in Appendix A.

  Soil Samples collected from Foundations B, C, D, and E were sampled for EP-toxicity metals. Barium was detected at 2.2 milligrams per liter (mg/L) in the leachate from the soil sample collected at Foundation B. This concentration is far below the corresponding regulatory limit of 100 mg/L (40 CFR 261.24). No other EP-toxicity metals were detected in any of the other floor drain samples.

- Four soil borings were drilled to 11 feet below ground surface near the three USTs that held gasoline and diesel fuel outside the fence west of the compound. No organic vapors were detected by the organic vapor detector in any of the soil samples collected from the borings. Analysis of the soil samples detected no EP-toxicity metals.

### 2.1.2 Safety and Health Risk Assessment

On October 12, 1989, a safety and health risk assessment was conducted at the millsite. During this assessment, it was noted that the electrical services had been de-energized at the west end of the site and that two transformers were present on a power pole located west of Building 2. These observations along with an additional survey performed on October 17, 1989, and the sampling survey conducted on September 12 - 17, 1989, are summarized in the *Occupational Risk Assessment, Bureau of Land Management (BLM) Compound, Monticello, Utah* (UNC Geotech 1990b). Observations listed in this document include, in addition to those listed above and in Section 2.1.1, a half-buried tank in the crawl space of the west end of Building 2 and possible polychlorinated biphenyl (PCB) contamination in the west end of Building 7.

### 2.1.3 BLM Site Walk-Through April 24, 1991

A second walk-through was conducted on April 24, 1991, to further investigate areas identified during the June 28, 1989, walk-through and by subsequent sampling events. The intended use of information gathered during this walk-through was to determine if additional sampling should be performed for priority pollutant contamination prior to remediation and to assist in the preparation of this Work Plan for the sampling. The areas targeted for special attention were the three USTs located to the west of the compound, the drums, the half-buried tank and explosive storage area in Building 2, the pit and drain in Foundation C, Drums 1 and 2 on the cistern, the liquid in the cistern, the transformers, possible PCB contamination in Building 7, and an old water-production well. The following paragraphs summarize the observations and the recommendations for follow-up action if warranted.

The three USTs that stored gasoline and diesel fuel contained between 0.2 and 0.4 foot of product on top of water. The depth to the bottom of the northern, middle, and southern tanks was 7.25 feet, 6.67 feet, and 9.87 feet, respectively. The tanks will be closed in accordance with the Utah Underground Storage Tank Regulations (USTR) R311-200 through R311-208 and R315-101. Sampling around the USTs, along the product piping, and at the dispenser island will be conducted in accordance with the terms of an approved Closure Plan. The Closure Plan will be prepared in accordance with USTR R311-204. Closure activities are scheduled to be conducted during the 1993 or 1994 field season.

The drums stored in the crawl space under Building 2 were verified as empty. Bob Turri, District Manager for the BLM, described an explosive storage area as located near the east wall of Building 2. This area was located and investigated; no evidence of explosives was found. No further sampling is warranted in these areas.

The "half-buried tank" under Building 2 is nearly buried; its use and contents are unknown. Two pipes exit the tank to an unknown location within the foundation. The contents of this tank, if any, and whether the tank or piping has leaked must be determined. Sampling should be performed during remediation because access to the area around the tank is currently limited by the 3-foot height of the crawl space and removal of the foundation and flooring to improve access would require asbestos abatement (Section 2.1.1). The piping will also be traced during remediation. The length of the piping and the terminal point may also be sampled. These activities will be discussed in the site remedial action design report.

The drain in Foundation C exits the foundation to the south and extends to Building 7, at which point it turns west. The terminal point of the drain pipe was not identified. Previous soil sampling indicated the presence of VOCs in sediments in the pit. Additional sampling is warranted along the drain pipe and at its terminus to determine if contamination exists in these areas.

Drum 1 on the cistern is full and contains approximately 2 feet of a lime-green liquid on top of a solid opaque white material. Drum 2 is labeled "Jet Fuel" but is approximately two-thirds full of water. The materials in the drums and the cistern require further characterization to determine proper disposal.

Two transformers were located on a power pole west of Building 2. Empire Electric Association removed the transformers under the guidance of Geotech's Health, Safety, and Security section in August 1991. Prior to remediation, the transformers were identified to be non-leaking. No leaks or spills were discovered or occurred during removal. No sampling is required in this area.

A valve pit was identified in the western-most bay of Building 7 and the soil inside the pit appeared oily. This pit is believed to be the area referred to in the *Risk Assessment* as containing possible PCB contamination. This area requires further characterization.

A 5-gallon bucket containing what appeared to be motor oil was present in one of the bays. The "motor oil" was approximately 2 inches deep. This item requires further characterization.

A 24-ounce-size tin of a rodenticide (2-pivalyl-1,3-indanedione), with approximately one-quarter to one-third of the contents still in the tin, was found in Building 10. As stated on the label of the rodenticide, the concentration of the active ingredient is 0.025 percent. At this concentration, the rodenticide is classified as "non-technical grade" or "concentrate" and is packaged for home use. If the tin receives a free release from radiological contamination, disposal of the tin will occur in accordance with all applicable requirements. A white powdery material was found on the floor of the building and was believed to be the rodenticide. No sampling is required in this area.

In summary, the items included in this Work Plan that were identified during the April 24, 1991, walk-through as areas needing further characterization are

- The Foundation C pit, drain pipe, and terminal point.
- The contents of Drums 1 and 2 and the cistern.
- The Building 7 valve pit.
- The 5-gallon bucket.

### 2.1.4 Other Issues

As discussed previously, Building 2's half-buried tank, associated piping, and terminal point will be sampled during remediation. These activities will be discussed in the site remedial action design report.

The three gasoline and diesel fuel USTs located immediately to the west of the BLM Compound will be sampled and closed in accordance with USTR R311-204, as a separate activity.

The suspected USTs near Buildings 2 and 6, and Foundation E have never been located. Adequate field investigations, including geophysical surveys, have been conducted to date to indicate that the suspected USTs do not exist. However, any excavation activities conducted around these areas will be performed under strict safety guidelines; such activities will be addressed in the site remedial action design report. In the unlikely event that USTs are discovered during remediation, all UST-related activities, including closure, will be conducted in accordance with Utah's UST requirements.

Asbestos insulation identified on pipe and in vinyl asbestos tiles in Buildings 2 and 6 and in vinyl asbestos tiles on Foundation A concrete will be managed in accordance with all applicable or relevant and appropriate requirements, including the Toxic Substances Control Act (TSCA). Additionally, a steam valve pipe located in a pit immediately north of Foundation A is insulated with material suspected of containing asbestos.

All batteries found on the BLM Compound were radiologically scanned and sent to a recycler during August 1991.

Drums 1 and 2 subsequently have been overpacked and reassigned new tracking numbers. Drum 1 is currently identified as Drum No. 569 while Drum 2 is identified as Drum No. 570. These drums currently are stored in Building 9 located on the BLM Compound.

# 3.0 OBJECTIVES

The objectives of this Work Plan are to describe the performance of the tasks necessary to determine if areas of nonradiological contamination exist at the BLM Compound. Specific areas to be characterized previously were identified and are listed in Section 2.1.3. In general, the results will be used to make recommendations concerning disposal options. In some instances, further characterization activities may be required on the basis of results of this sampling effort. Table 3-1 specifies the analytical parameters and methods to be used for the BLM Compound characterization. Analysis performed by Geotech will use Geotech Standard Operating Procedures which employ methods equivalent to the EPA method cited.

Information obtained from this characterization activity will be compiled into a site characterization assessment report. This report will be used to prepare the site remedial action design report.

## 3.1 Foundation C Drainpipe

The objectives of this Work Plan for the Foundation C drainpipe area are to determine the extent of the drainpipe and whether soil contamination has occurred along the length of the pipe, at its terminus, or outside of the drain pit. The extent of the drainpipe will be determined by excavating until its terminus has been located.

### 3.1.1 Sampling and Analytical Design

An organic vapor detector will be used to check each joint along the length of the exposed pipe and any sections of the pipe where a leak is expected. Soil samples will be collected at each location where the photoionization detector measures organic vapors at concentrations of 5 ppm above background or greater. Each sample will be collected over a 6-inch depth of soil beginning at the depth that corresponds to the midpoint of the pipe. For planning purposes, it is assumed that three soil samples will be collected along the drainpipe.

**Table 3-1. Analytical Parameters, Methods, and Reporting Limits**

| Analytical Parameter | Analytical Method[1] | |
|---|---|---|
| <u>Target Compound List Volatile Organic Compounds</u> "TCL-VOC" | Geotech Method BB-1; EPA Methods 8240 or 8260 | |
| | <u>Reporting Limit</u> | |
| | Liquid (μg/L) | Soil (μg/kg) |
| Acetone | 10 | 10 |
| Benzene | 5 | 5 |
| Bromodichloromethane | 5 | 5 |
| Bromoform | 5 | 5 |
| Bromomethane | 10 | 10 |
| 2-Butanone | 10 | 10 |
| Carbon disulfide | 5 | 5 |
| Carbon tetrachloride | 5 | 5 |
| Chlorobenzene | 5 | 5 |
| Chloroethane | 10 | 10 |
| Chloroform | 5 | 5 |
| Chloromethane | 10 | 10 |
| Dibromochloromethane | 5 | 5 |
| 1,1-Dichloroethane | 5 | 5 |
| 1,2-Dichloroethane | 5 | 5 |
| 1,1-Dichloroethene | 5 | 5 |
| *cis*-1,2-Dichloroethene | 5 | 5 |
| *trans*-1,2-Dichloroethene | 5 | 5 |
| 1,2-Dichloropropane | 5 | 5 |
| *cis*-1,3-Dichloropropene | 5 | 5 |
| *trans*-1,3-Dichloropropene | 5 | 5 |
| Ethylbenzene | 5 | 5 |
| 2-Hexanone | 10 | 10 |
| Methylene chloride | 5 | 5 |
| 4-Methyl-2-pentanone | 10 | 10 |
| Styrene | 5 | 5 |
| 1,1,2,2-Tetrachloroethane | 5 | 5 |
| Tetrachloroethene | 5 | 5 |
| Toluene | 5 | 5 |
| 1,1,1-Trichloroethane | 5 | 5 |
| 1,1,2-Trichloroethane | 5 | 5 |
| Trichloroethene | 5 | 5 |
| Vinyl acetate | 10 | 10 |
| Vinyl chloride | 10 | 10 |
| *o*-Xylene | 5 | 5 |
| *m,p*-Xylene | 5 | 5 |

[1] Geotech Methods listed are Geotech's standard operating procedures for the EPA Method listed. Geotech Methods meet or exceed the corresponding EPA Methods in precision and accuracy.

Table 3-1 (continued). **Analytical Parameters, Methods, and Reporting Limits**

| **Analytical Parameter** | **Analytical Method**[1] | |
|---|---|---|
| Target Compound List Semi Volatile Organic Compounds "TCL-semi-VOC" | Geotech Method BB-2; EPA Method 8270 | |
| | Reporting Limit | |
| | Liquid ($\mu$g/L) | Soil ($\mu$g/kg) |
| Acenaphthene | 10 | 330 |
| Acenaphthylene | 10 | 330 |
| Anthracene | 10 | 330 |
| Benzo(a)anthracene | 10 | 330 |
| Benzo(b)fluoranthene | 10 | 330 |
| Benzo(k)fluoranthene | 10 | 330 |
| Benzo(g,h,i)perylene | 10 | 330 |
| Benzo(a)pyrene | 10 | 330 |
| Bis(2-chloroethoxy)methane | 10 | 330 |
| Bis(2-chloroethyl)ether | 10 | 330 |
| Bis(2-ethylhexyl)phthalate | 10 | 330 |
| 4-Bromophenyl phenyl ether | 10 | 330 |
| Butylbenzylphthalate | 10 | 330 |
| Carbazole | 10 | 330 |
| 4-Chloroaniline | 10 | 330 |
| 2-Chloronaphthalene | 10 | 330 |
| 4-Chloro-3-methylphenol | 10 | 330 |
| 2-Chlorophenol | 10 | 330 |
| 4-Chlorophenyl phenyl ether | 10 | 330 |
| Chrysene | 10 | 330 |
| Dibenz(a,h)anthracene | 10 | 330 |
| Dibenzofuran | 10 | 330 |
| Di-n-butylphthalate | 10 | 330 |
| 1,2-Dichlorobenzene | 10 | 330 |
| 1,3-Dichlorobenzene | 10 | 330 |
| 1,4-Dichlorobenzene | 10 | 330 |
| 3,3'-Dichlorobenzidine | 10 | 330 |
| 2,4-Dichlorophenol | 10 | 330 |
| Diethylphthalate | 10 | 330 |
| 2,4-Dimethylphenol | 10 | 330 |
| Dimethylphthalate | 10 | 330 |
| 4,6-Dinitro-2-methylphenol | 25 | 800 |
| 2,4-Dinitrophenol | 25 | 800 |
| 2,4-Dinitrotoluene | 10 | 330 |
| 2,6-Dinitrotoluene | 10 | 330 |
| Di-n-octylphthalate | 10 | 330 |
| Fluoranthene | 10 | 330 |
| Fluorene | 10 | 330 |
| Hexachlorobenzene | 10 | 330 |
| Hexachlorobutadiene | 10 | 330 |
| Hexachlorocyclopentadiene | 10 | 330 |
| Hexachloroethane | 10 | 330 |

Table 3-1 (continued). **Analytical Parameters, Methods, and Reporting Limits**

| Analytical Parameter | Analytical Method[1] | |
|---|---|---|
| Target Compound List Semi Volatile Organic Compounds "TCL-semi-VOC" (continued) | Geotech Method BB-2; EPA Method 8270 | |
| | Reporting Limit | |
| | Liquid (µg/L) | Soil (µg/kg) |
| Indeno(1,2,3-cd)pyrene | 10 | 330 |
| Isophorone | 10 | 330 |
| 2-Methylnaphthalene | 10 | 330 |
| 2-Methylphenol | 10 | 330 |
| 4-Methylphenol | 10 | 330 |
| Naphthalene | 10 | 330 |
| 2-Nitroaniline | 25 | 800 |
| 3-Nitroaniline | 25 | 800 |
| 4-Nitroaniline | 25 | 800 |
| Nitrobenzene | 10 | 330 |
| 2-Nitrophenol | 10 | 330 |
| 4-Nitrophenol | 25 | 800 |
| N-Nitroso-di-n-dipropylamine | 10 | 330 |
| 2,2'-Oxybis(1-chloropropane) | 10 | 330 |
| N-Nitrosodiphenylamine | 10 | 330 |
| Pentachlorophenol | 25 | 800 |
| Phenanthrene | 10 | 330 |
| Phenol | 10 | 330 |
| Pyrene | 10 | 330 |
| 1,2,4-Trichlorobenzene | 10 | 330 |
| 2,4,5-Trichlorophenol | 25 | 800 |
| 2,4,6-Trichlorophenol | 10 | 330 |
| Target Compound List Polychlorinated Biphenyls "PCBs" | Geotech Method AA-4; EPA Method 8080 | |
| | Reporting Limit | |
| | Liquid (µg/L) | Soil (µg/kg) |
| Aroclor 1016 | 0.5 | 80.0 |
| Aroclor 1221 | 0.5 | 80.0 |
| Aroclor 1232 | 0.5 | 80.0 |
| Aroclor 1242 | 0.5 | 80.0 |
| Aroclor 1248 | 0.5 | 80.0 |
| Aroclor 1254 | 1.0 | 80.0 |
| Aroclor 1260 | 1.0 | 80.0 |

Table 3-1 (continued). **Analytical Parameters, Methods, and Reporting Limits**

| Analytical Parameter | Analytical Method[1] | | |
|---|---|---|---|
| Total Petroleum Hydrocarbons "TPH" | Geotech Method CC-1; EPA Method 418.1 | | |
| | | Reporting Limit | |
| | | Liquid (µg/L) | Soil (µg/kg) |
| TPH-Oil | | 500 | 10,000 |
| Priority Pollutant Metals List "Metals" | Geotech Digest Method L-22[2]; Digested by EPA Methods 3050, 3010, and/or 3020. Analysis by Geotech Methods AS-2, AS-3, AS-5, and AS-6. Analysis by EPA 7000 Series, 6010 and/or 6020. | | |
| | | Reporting Limit | |
| | | Liquid (µg/L) | Soil (µg/kg) |
| Antimony | | 60 | 1,200 |
| Arsenic | | 10 | 200 |
| Beryllium | | 5 | 100 |
| Cadmium | | 5 | 100 |
| Chromium | | 10 | 200 |
| Copper | | 25 | 500 |
| Lead | | 3 | 60 |
| Mercury | | 0.2 | 4 |
| Nickel | | 40 | 800 |
| Selenium | | 5 | 100 |
| Silver | | 10 | 200 |
| Thallium | | 10 | 200 |
| Zinc | | 20 | 400 |
| Asbestos | Geotech Method ASB-04-89 and TIL-04-89; 40 CFR Part 763, Subpart F, Appendix A. | | |
| Asbestos Species | | N/A[3] | N/A[3] |

[2] Geotech Digest Method L-22 is equivalent to the digest method in the EPA Contract Laboratory Program 3/90 Statement of Work.

[3] Bulk, tile, and soil asbestos analysis reported by volume in 1% increments.

Table 3-1 (continued). **Analytical Parameters, Methods, and Reporting Limits**

| Analytical Parameter | Analytical Method[1] |
|---|---|
| Toxicity Characteristic Leachate Procedure "TCLP Constituents" | Extraction: Geotech Method L-20; EPA Method 1311 and 40 CFR 261 Appendix II. |
| TCLP Metals: | Metals Analysis: Geotech Methods AS-2, AS-3, AS-4, AS-5, AS-6, of F-6 and F-8; EPA Method 6010, 6020, 700 Series, 335.2 or 250.1. |
| | Reporting Limit[4] Extract (mg/L) |
| Arsenic | 5.0 |
| Barium | 100.0 |
| Cadmium | 1.0 |
| Chromium | 5.0 |
| Lead | 5.0 |
| Mercury | 0.2 |
| Selenium | 1.0 |
| Silver | 5.0 |
| TCLP Organics: | Organic Analysis: Geotech Method BB-1 or BB-2; EPA Method 8240, 8260, or 8270. |
| | Reporting Limit[4] Extract (mg/L) |
| Benzene | 0.5 |
| Carbon Tetrachloride | 0.5 |
| Chlordane | 0.03 |
| Chlorobenzene | 100.0 |
| Chloroform | 6.0 |
| *o*-Cresol | 200.0 |
| *m*-Cresol | 200.0 |
| *p*-Cresol | 200.0 |
| Cresol | 200.0 |
| 1,4-Dichlorobenzene | 7.5 |
| 1,2-Dichloroethane | 0.5 |
| 1,1-Dichloroethylene | 0.7 |
| 2,4-Dinitrotoluene | 0.13 |
| Heptachlor | 0.008 |
| Hexachlorobenzene | 0.13 |
| Hexachlorobutadiene | 0.5 |
| Hexachloroethane | 3.0 |
| Methyl ethyl ketone | 200.0 |
| Nitrobenzene | 2.0 |
| Pentachlorophenol | 100.0 |

[4] These reporting limits represent the TCLP regulatory limits; Geotech's reporting limits will be below these values.

Table 3-1 (continued). **Analytical Parameters, Methods, and Reporting Limits**

| Analytical Parameter | Analytical Method[1] |
|---|---|
| <u>Toxicity Characteristic Leachate Procedure</u> "TCLP Constituents" (continued) | <u>Extraction:</u> Geotech Method L-20; EPA Method 1311 and 40 CFR 261 Appendix II. |
| <u>TCLP Organics:</u> (continued) | <u>Organic Analysis:</u> Geotech Method BB-1 or BB-2; EPA Method 8240, 8260, or 8270. |
| | <u>Reporting Limit</u>[4] Extract (mg/L) |
| Pyridine | 5.0 |
| Tetrachloroethylene | 0.7 |
| Trichloroethylene | 0.5 |
| 2,4,5-Trichlorophenol | 400.0 |
| 2,4,6-Trichlorophenol | 2.0 |
| Vinyl Chloride | 0.2 |
| <u>TCLP Pesticides/Herbicides:</u> | <u>Pesticides/Herbicides Analysis:</u> Geotech Method AA-3 or AA-4; EPA Method 8150 or 8080. |
| | <u>Reporting Limit</u>[4] Extract (mg/L) |
| 2-4 D | 10.0 |
| Endrin | 0.02 |
| Lindane | 0.4 |
| Methoxychlor | 10.0 |
| Toxaphene | 0.5 |
| 2,4,5-TP (Silvex) | 1.0 |

Two soil borings will be drilled at the drain pit. One boring will be drilled adjacent to the area where the drainpipe enters the pit. The other boring will be drilled into the soil outside of the pit, directly across from the first hole. Each boring will be drilled to 6 feet and undisturbed samples will be collected at 2-, 4-, and 6-foot depths. The sampled interval from each boring which exhibits the highest organic vapors (based upon a field photoionization detector measurement) will be submitted for laboratory analysis.

Two soil borings will also be drilled at the drainpipe terminus. The soil borings will be drilled 1 foot from the pipe terminus and 1.5 feet apart. Each boring will be drilled to 6 feet (measured from the base of the drainpipe) and undisturbed samples will be collected at 2-, 4-, and 6-foot depths (measured from the base of the drainpipe). The sampled interval from each boring that exhibits the highest organic vapors (based upon a field photoionization detector measurement) will be submitted for laboratory analysis.

All samples will be analyzed for TCL-VOCs, TCL-semi-VOCs, and Priority Pollutant metals (metals).

### 3.1.2 Other Issues

In the event that the terminus of the drainpipe is a septic tank, the terminus soil borings discussed above will not be drilled. The contents of the tank (both liquids and sludges) will be sampled in a manner consistent with sampling activities prescribed for the cistern (see Sections 3.2, 4.1, and 4.2). The need for follow-up characterization activities (i.e., soils below the tank or a leach field associated with the tank) will be assessed depending upon the analytical results of the septic tank samples. Such follow-up activities, if required, will be consistent with activities prescribed in this Work Plan and will be included in the site remedial action design report.

## 3.2 Cistern and Drums

The two drums that were located on top of the cistern will be sampled to provide a more complete characterization of both the liquid and solid phases present. The liquid in the cistern and any detected sludges will be sampled for characterization purposes.

### 3.2.1 Sampling and Analytical Design

Three liquid samples will be obtained from the drums and cistern using a composite liquid waste sampler (COLIWASA) or similar column sampling device. The liquid sample from the cistern will be submitted for TCL-VOCs and TCL-semi-VOCs analyses. In the event that solids (sludges) are present in the cistern, one sample will be collected using a soil-boring device. This sample will be submitted for TCL-VOCs, TCL-semi-VOCs and metals analyses. The samples from the drums will be submitted for TCL-VOCs and metals analyses. One solid sample will be collected from Drum No. 569 (Drum 1) using a soil-boring device. This sample will be submitted for TCL-VOCs, TCL-semi-VOCs, and metals analyses.

### 3.2.2 Other Issues

The contents of the cistern will be emptied and containerized prior to remediation. This will be discussed in the site remedial action design report. Subsequent management of this material will be dependent upon the result of the analysis previously discussed.

## 3.3 Building 7 Valve Pit and Bucket

The valve pit in the west end of Building 7 and the liquid in the bucket will be sampled to determine if the materials must be treated as TSCA wastes. The initial sampling in the valve pit will determine if additional sampling is warranted in this area and along any associated piping.

### 3.3.1 Sampling and Analytical Design

One surface soil sample will be collected from the valve pit and one liquid sample will be collected from the bucket in Building 7. These samples will be submitted for total petroleum hydrocarbons (TPH)-Oil and PCB analyses.

### 3.3.2 Other Issues

The piping and the terminal points of the valve pit will be traced to the extent possible during the characterization activities. Characterization along the pipe and at the terminal point will be conducted in a manner consistent with the Foundation C drainpipe characterization (Section 3.1). Any liquids detected will be sampled in a manner consistent with the cistern and drums characterization (Section 3.2).

In the event that the piping cannot be traced during characterization activities (because the valve pit is located within a building), the piping and terminal points will be located during site remediation. This additional characterization, if applicable, will be addressed in the site remediation action plan. Such follow-up activities, if required, will be conducted in a manner consistent with activities prescribed in this Work Plan and will be included in the site remedial action design report.

### 3.4 Steampipe Insulation

The insulation on the steampipe located in a pit immediately north of Foundation A will be sampled and analyzed to determine if the material contains asbestos.

#### 3.4.1 Sampling and Analytical Design

One bulk grab sample will be collected from the suspect insulation. If required, the sample will be cut from the piping. This sample will be submitted for asbestos analysis.

### 3.5 Unidentified Areas

Additional suspect areas (i.e., soil staining) not identified within this Work Plan may be field identified during the performance of these characterization activities. Such areas will be characterized in a manner consistent with procedures identified in this Work Plan.

Any additional batteries discovered on the BLM Compound will be collected, radiologically scanned, and submitted to a recycler.

## 4.0 FIELD INVESTIGATION PROCEDURES

This section provides a general description of the equipment, methods, and procedures to be used by the sampling team for collecting samples in the field. All field activities will be performed by properly trained Geotech employees. All samples will be field scanned for radioactivity using a beta-gamma detector, an alpha-particle detector, a gamma-scintillometer, and/or an opposed crystal system to aid in decisions to be made concerning packaging, handling, and shipping. All sample shipments will comply with the Department of Transportation requirements specified in 49 CFR 171 through 178.

Appendix B presents step-by-step procedures for performing the tasks associated with sampling. Sampling procedures are further specified in the *Monticello Mill Tailings Site Bureau of Land Management Compound Characterization Sampling and Analysis Plan* (in progress). Table 4-1 contains a summary of the sampling locations, type, sampling technique, and analytes for each site.

**Table 4-1. Summary of Sampling Activities**

| Location | Sample Type | Sampling Technique | Analytes |
|---|---|---|---|
| Foundation C Drain Pit, Pipe and Terminus | Subsurface Soils | Barrel Auger and Beaver Auger | TCL-VOCs, TCL-semi-VOCs, and metals |
| Cistern | Liquids | Column-Type Sampler | TCL-VOCs and TCL-semi-VOCs |
| | Sludge | Barrel Auger | TCL-VOCs, TCL-semi-VOCs, and metals |
| Drums No. 569 and No. 570 (Drums 1 and 2, respectively) | Liquids | Column-Type Sampler | TCL-VOCs and metals |
| Drum No. 569 (Drum 1) | Sludge | Barrel Auger | TCL-VOCs, TCL-semi-VOCs, and metals |
| Building 7 Valve Pit | Surface Soils | Barrel Auger | TPH-Oil and PCBs |
| Building 7 Bucket | Liquid | Poured Sample | TPH-Oil and PCBs |
| Pipe Insulation | Grab | Bulk Sampling | Asbestos |
| Decontamination Rinsate | Liquid | Column-Type Sampler | TCLP Constituents |

## 4.1 Soil and Sediment Sampling

Prior to all sampling activities, the sampling equipment will be cleaned using the decontamination procedures described in Section 4.4.

### 4.1.1 Barrel Auger

A barrel auger will be used to penetrate surface or near-surface soil to the desired depth to obtain a sample for analysis. The sampling equipment will consist of a stainless steel auger bit attached to a stainless steel rod and "T" handle. The auger bit will be used to bore a hole to the desired depth and then will be withdrawn. The barrel portion of the auger bit holds the soil cuttings and eliminates contact with the sidewall of the borehole, which minimizes the potential of contaminating the soil from other parts of the hole.

Soil from the desired depth will be removed from the auger barrel using a stainless steel spoon or knife. The sample will be immediately placed into the sample containers. Care will be taken not to aerate the sample.

4.1.2 Beaver Auger Machine

A beaver auger machine will be used when the sampling location is too deep to make non-machine drilling practical as determined by the sampling team. The beaver auger will drill to the depth for sample collection and then will be withdrawn from the borehole. Extension rods will be attached to the barrel auger, and the sample will be collected as described in Section 4.1.1.

**4.2 Liquid Sampling**

A column-type sampler such as a COLIWASA will be used to collect representative composite liquid samples from the cistern and drums. The sampler will be submerged in the liquid until the bottom of the container is reached or until a solid medium is encountered. The opening at the bottom of the sampler will then be closed or some other method will be employed so that the liquid does not drain from the sampler as the sampler is withdrawn. The column-type sampler will be used to directly dispense the sample into the containers.

The samples from the bucket in Building 7 will be collected by pouring the liquid directly into the sample container.

The containers of liquid samples collected for organic analysis will be filled to eliminate headspace.

**4.3 Equipment Requirements**

Equipment and supplies used for field investigation activities may include

- Barrel Auger
- Beaver Auger Machine
- Stainless Steel Spoon, Knife and Ladle
- Stainless Steel Funnel
- Column-Type Sampler
- Latex, Nitrile, and Silver Shield™ Surgical Gloves
- Leather Gloves
- Stainless Steel Trays
- Tape Measure
- Field Logbook
- Sample Labels
- Chain of Custody Forms
- Cooler with Ice (or equivalent)
- Sample Containers/Preservatives
- Decontamination Solutions and Supplies
- Waste Containers
- Photoionization Detector
- Beta-Gamma Detector
- Alpha-Particle Detector
- Gamma-Ray Scintillometer
- Opposed Crystal System
- Empty 55-gallon Drums
- Visqueen™

**4.4 Decontamination of Sampling Equipment**

Decontamination of nondedicated sampling and drilling equipment shall be accomplished by combining Methods B and C in "Standard Practice for Equipment Decontamination," Appendix B. Specifically, decontamination will include washing with soapy water (Alconox™ laboratory soap or equivalent), followed by a potable water rinse, methanol rinse, and finally a deionized water rinse.

All sampling and drilling equipment will be surveyed for radiological contamination by a qualified Occupational Health and Safety technician before moving on to the next sample location. Decontaminated equipment will be stored in a manner that protects it from contamination until further use.

All decontaminant rinsate will be collected and placed into a clean 55-gallon drum. The container will be kept closed. The container will be labeled such that the contents and the dates when the rinsate was added are identified. At the conclusion of the BLM Compound characterization activities, a rinsate sample will be collected, as described in Section 4.2 for Toxicity Characteristic Leachate Procedure (TCLP) constituent (includes metals, organics and pesticides/herbicides) analysis. Disposal of the stored rinsate will be determined pending evaluation of the TCLP analytical data.

### 4.5 Sample Identification and Handling Procedures

Each sample will be assigned a unique alphanumeric number and a unique site identification descriptor corresponding to the location where the sample was taken. Samples collected for quality assurance purposes will be assigned unique alphanumeric numbers and descriptors so that the laboratory is unaware of their true identity. A detailed description of labeling requirements and procedures is presented in "Standard Practice for Sample Labeling," Appendix B.

Requirements for sample containers, sample volumes, preservation methods, and holding times are specified in the *Monticello Mill Tailings Site Bureau of Land Management Compound Characterization Sampling and Analysis Plan* (in progress). Sample bottles containing liquid or solid samples intended for VOC analyses will be filled with minimum headspace. The 40-milliliter (mL) vials containing liquid for TCL-VOCs analyses will be filled with no headspace or bubbles.

Sample containers purchased for organic sample collection will be pre-cleaned and obtained from U.S. Environmental Protection Agency (EPA)-approved supplier for Superfund sites (e.g., I-Chem). Containers will be inspected for integrity and cleanliness before use. Suspect containers will not be used and will be labeled "Do Not Use" or discarded.

Samples will be preserved immediately upon collection. For acidified samples, pH will be checked prior to shipment to ensure proper preservation. Samples requiring refrigeration for preservation will be stored and shipped in a cooler with Blue Ice™ and/or wet ice. Samples will be packaged, labeled, and shipped according to U.S. Department of Transportation regulations in 49 CFR Parts 171 through 178.

Each shipment of samples will be accompanied by a signed Chain of Sample Custody form that specifies the analyses required for each sample and any unique handling requirements based on information obtained in the field. Samples collected on Friday, Saturday, and Sunday will be shipped the following Monday (Appendix B).

## 5.0 ANALYTICAL PROCEDURES

All characterization samples collected at the BLM Compound will be analyzed by the Geotech Analytical Chemistry Laboratory. All analytical activities will be performed by properly trained Geotech employees. EPA and the State have access rights to the analytical laboratory used to conduct this work and may, at their discretion, introduce blind QA samples (i.e., Duplicate Blanks and Performance Evaluation Samples). Reporting limits that will be used for analysis of samples obtained from the BLM Compound characterization are included in Table 3-1. Following analysis, the excess sample portions may be returned by the laboratory to the MMTS.

# 6.0 QUALITY ASSURANCE AND QUALITY CONTROL

This section describes the quality assurance and quality control measures used for sampling and analysis. The objective is to provide systematic control of all tasks to maximize comparability, completeness, representativeness, accuracy, and precision.

## 6.1 Sampling Procedures

Basic sampling procedures are described in Section 4.0 of this document; detailed procedures are presented in Appendix B. Any deviation from these procedures will be noted in the field logbook with an explanation and a description of its possible impact on data quality.

## 6.2 Sample Control

To maintain evidence of authenticity, the samples collected must be properly identified and easily discernible from other like samples. Samples collected during the BLM Compound characterization will be identified by a label attached to the sample container that will contain the sample identification number, location, date and time collected, and the sampler's name.

Each sample cooler will have a custody seal placed over its lid to demonstrate that it has been kept under custody from the time it was collected to the time it was analyzed. Chain of Sample Custody records will be used to list all transfers in the possession of the samples. The Chain of Sample Custody form will show that the sample was in constant custody between collection and analysis.

While the sample is in shipment, the shipping cooler will have custody seals placed over the cooler opening to ensure the integrity of the samples. The receiving laboratory will note the condition of the sample containers (e.g., broken bottles, leaking bottles, etc.).

## 6.3 Document Control

A bound logbook with consecutively pre-numbered pages will be used by the sampling team to record field measurements and observations that may affect the quality of the data. Information to be recorded in the logbook includes the sample number, location, time and date of sample collection, sampler, type of sample, and field measurement data (including instrument calibration information). The daily activities of the team, personnel present, and the weather conditions during sampling will also be recorded.

A copy of each Chain of Sample Custody form will be retained by the field team for traceability in case of sample loss. These forms will become part of the permanent project file upon project completion. Copies received by the laboratory will also be maintained in a project file until the analytical work is completed; they will then be transferred to the permanent project file. All information gathered during the course of the fieldwork and all sample analyses results will be sent to the Technical Monitor upon completion of the sampling and analysis.

## 6.4 Field Quality Assurance

Quality assurance procedures applicable to field activities include following the standard operating procedures discussed in Section 4.0 and the collection of quality control samples. The types of quality control samples collected will include trip blanks, equipment blanks, and duplicate samples. Collection frequencies and types of analysis to be performed are summarized in Table 6-1.

**Table 6-1. Collection Frequency of Quality Assurance Samples**

| Sample Type | Analysis | Frequency |
|---|---|---|
| Trip Blanks | TCL-VOC | One per cooler of TCL-VOC samples |
| Equipment Blanks | Same as environmental samples | One for every 10 environmental samples or one for every group of environmental samples less than 10 |
| Duplicates | Same as environmental samples | One for every 10 environmental samples or one for every group of environmental samples less than 10 |

### 6.4.1 Blanks

Trip blanks are samples of deionized water that are used as a check on sample integrity from the time of sample collection to the time of analysis. Trip blanks will be prepared at the start of the first sampling day by the sampling team using organic-free deionized or distilled water. Blank samples will be handled in the same manner and analyzed for the same compounds as the environmental samples. At least one trip blank will be included with each cooler of TCL-VOC samples.

Equipment blanks are samples of the final deionized rinse water that were used to decontaminate sampling equipment. Equipment blanks will be collected at a frequency of one for every 10 environmental samples. At a minimum, one equipment blank will also be collected for environmental sample groups that contain fewer than 10 samples. Equipment blanks, which will be analyzed for the same compounds as the environmental samples, provide a check on the effectiveness of the decontamination process. Field controls for minimizing the potential of cross-contamination are specified in Section 4.4 and Appendix B.

### 6.4.2 Duplicates

Duplicate samples will be collected at a frequency of one for every 10 environmental samples. One duplicate sample will also be collected for environmental sample groups that contain fewer than 10 samples. To the extent possible, duplicate samples of liquid matrices will be collected to eliminate data inconsistencies that may be caused by the heterogeneous nature of soil samples. These samples will be handled in the same manner as the original sample except that they will be labeled with a new sample identification number so that the laboratory is unaware that the sample is a duplicate. Duplicate samples will be analyzed for the same compounds as the environmental samples.

### 6.5 Laboratory Quality Control

The Geotech Analytical Chemistry Laboratory will follow all relevant EPA (SW-846) and Geotech laboratory procedures. Analytical quality control will include analysis of blanks, duplicates, spikes, surrogate samples, check samples, and instrument calibration, as specified by the method. Replicate samples will be collected at a frequency of one per analysis per sampling event for use by the laboratory for running matrix-spike/matrix-spike duplicate analyses.

## 7.0 MANAGEMENT OF INVESTIGATIVE WASTES

All investigative wastes generated during sampling will be placed into containers. Investigative wastes will be segregated by location to the extent possible. Each segregated waste will be placed in a plastic bag, jar, or drum, and the container will be labeled. Labeling information will be as detailed as possible and at a minimum will include the location, date of collection, and a corresponding sample number, if possible. Each segregated container will subsequently be placed into a 55-gallon drum. An inventory record will be maintained of all the material placed into or removed from the drum. The drum will also be labeled and maintained under secured conditions. To the extent possible, subsequent management of the investigative wastes will be based upon the corresponding samples analytical data. The management of this material will be conducted in accordance with all applicable requirements.

## 8.0 DATA REVIEW

All data collected during field sampling activities and reported by the analytical laboratory will be evaluated by the Technical Monitor for completeness. Laboratory data shall also be evaluated for adherence to quality control criteria. After review of field and laboratory data, the Technical Monitor shall write a "memorandum to file" summarizing the review findings and interpreting the results. The "memorandum to file" shall include a determination of the need for additional sampling to define the extent of contamination. A site characterization assessment report will be prepared to evaluate the characterization activities. This report will be used to prepare the site remedial action design report.

## 9.0 HEALTH AND SAFETY

All field work will be performed in accordance with the *Monticello Mill Tailings Site Health and Safety Plan* (in progress). This plan describes the health and safety responsibilities of Geotech personnel, defines the procedures to be used, describes the required safety training, establishes protective equipment requirements, describes potential contaminants and their exposure limits, describes plans for emergency response, and provides guidance for spill cleanup and abatement.

## 10.0 REFERENCES


40 CFR 260 through 268, 1992. U.S. Environmental Protection Agency, *U.S. Code of Federal Regulations.*

49 CFR 171 through 178, 1992. U.S. Environmental Protection Agency, *U.S. Code of Federal Regulations.*

Chem-Nuclear Geotech, Inc. 1992. *Monticello Mill Tailings Site, Operable Units I, II, and III, Quality Assurance Program Plan*, Grand Junction Colorado, October 1990. P-GJPO-123.

RUST Geotech Inc. 1993. *Environmental Procedures Catalog* (Manual 116), Grand Junction, Colorado.

RUST Geotech Inc. (in progress) *Monticello Mill Tailings Site Bureau of Land Management Compound Characterization Sampling and Analysis Plan.*

RUST Geotech Inc. (in progress). *Monticello Mill Tailings Site Health and Safety Plan.*

UNC Geotech, Inc., 1990a. *Final Remedial Investigation/Feasibility Study - Environmental Assessment for the Monticello Uranium Mill Tailings Site, Volume I and II*, Grand Junction, Colorado, January 1990. DOE/EA-0424.

UNC Geotech, Inc., 1990b. *Occupational Risk Assessment, Bureau of Land Management (BLM) Compound, Monticello, Utah*, Grand Junction, Colorado, February 1990.

U.S. Environmental Protection Agency, 1990. *Test Methods for Evaluating Solid Waste*, Office of Solid Waste and Emergency Response, Washington, D.C.

# APPENDIX A

# ANALYTICAL REPORTS

# 1A
# VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MLA533

Lab Name: ITAS-KNOXVILLE Contract: 29690

Lab Code: IT-MWL Case No.: 00181 SAS No.: NA SDG No.: 35621

Matrix: (soil/water) SOIL Lab Sample ID: MM0333

Sample wt/vol: 1.0 (g/mL) G Lab File ID: MM0333

Level: (low/med) LOW Date Received: 09/16/89

% Moisture: not dec. 28 Date Analyzed: 09/20/89

Column: (pack/cap) PACK Dilution Factor: 1.0

| CAS NO. | COMPOUND | CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG | Q |
|---|---|---|---|
| 74-87-3 | Chloromethane | 69 | U |
| 74-83-9 | Bromomethane | 69 | U |
| 75-01-4 | Vinyl Chloride | 69 | U |
| 75-00-3 | Chloroethane | 69 | U |
| 75-09-2 | Methylene Chloride | 1200 | B |
| 67-64-1 | Acetone | 2000 | E |
| 75-15-0 | Carbon Disulfide | 35 | U |
| 75-35-4 | 1,1-Dichloroethene | 29 | J |
| 75-34-3 | 1,1-Dichloroethane | 35 | U |
| 540-59-0 | 1,2-Dichloroethene (total) | 14 | J |
| 67-66-3 | Chloroform | 2600 | E |
| 107-06-2 | 1,2-Dichloroethane | 99 | |
| 78-93-3 | 2-Butanone | 660 | B |
| 71-55-6 | 1,1,1-Trichloroethane | 35 | U |
| 56-23-5 | Carbon Tetrachloride | 35 | U |
| 108-05-4 | Vinyl Acetate | 44 | J |
| 75-27-4 | Bromodichloromethane | 35 | U |
| 78-87-5 | 1,2-Dichloropropane | 35 | U |
| 10061-01-5 | cis-1,3-Dichloropropene | 30 | J |
| 79-01-6 | Trichloroethene | 1200 | |
| 124-48-1 | Dibromochloromethane | 35 | U |
| 79-00-5 | 1,1,2-Trichloroethane | 35 | U |
| 71-43-2 | Benzene | 81 | |
| 10061-02-6 | Trans-1,3-Dichloropropene | 35 | U |
| 75-25-2 | Bromoform | 35 | U |
| 108-10-1 | 4-Methyl-2-Pentanone | 1900 | BE |
| 591-78-6 | 2-Hexanone | 69 | U |
| 127-18-4 | Tetrachloroethene | 640 | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 35 | U |
| 108-88-3 | Toluene | 1300 | B |
| 108-90-7 | Chlorobenzene | 35 | U |
| 100-41-4 | Ethylbenzene | 1000 | |
| 100-42-5 | Styrene | 35 | U |
| ---------------- | Total Xylenes | 5800 | E |

1B
# SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MLA589

Lab Name: ITAS-KNOXVILLE Contract: 29690

Lab Code: ITMWL Case No.: MS00181 SAS No.: NA SDG No.: 35625

Matrix: (soil/water) WATER Lab Sample ID: MM0346

Sample wt/vol: 100 (g/mL) ML Lab File ID: MM0346

Level: (low/med) LOW Date Received: 09/23/89

% Moisture: not dec. ____ dec. ____ Date Extracted: 09/28/89

Extraction: (SepF/Cont/Sonc) SEPF Date Analyzed: 10/11/89

GPC Cleanup: (Y/N) N pH: 6.0 Dilution Factor: 1.0

| CAS NO. | COMPOUND | CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L | Q |
|---|---|---|---|
| 108-95-2 | Phenol | 100 | U |
| 111-44-4 | bis(2-Chloroethyl)Ether | 100 | U |
| 95-57-8 | 2-Chlorophenol | 100 | U |
| 541-73-1 | 1,3-Dichlorobenzene | 100 | U |
| 106-46-7 | 1,4-Dichlorobenzene | 100 | U |
| 100-51-6 | Benzyl Alcohol | 100 | U |
| 95-50-1 | 1,2-Dichlorobenzene | 100 | U |
| 95-48-7 | 2-Methylphenol | 100 | U |
| 39638-32-9 | bis(2-Chloroisopropyl)Ether | 100 | U |
| 106-44-5 | 4-Methylphenol | 100 | U |
| 621-64-7 | N-Nitroso-Di-n-Propylamine | 100 | U |
| 67-72-1 | Hexachloroethane | 100 | U |
| 98-95-3 | Nitrobenzene | 100 | U |
| 78-59-1 | Isophorone | 100 | U |
| 88-75-5 | 2-Nitrophenol | 100 | U |
| 105-67-9 | 2,4-Dimethylphenol | 100 | U |
| 65-85-0 | Benzoic Acid | 500 | U |
| 111-91-1 | bis(2-Chloroethoxy)Methane | 100 | U |
| 120-83-2 | 2,4-Dichlorophenol | 100 | U |
| 120-82-1 | 1,2,4-Trichlorobenzene | 100 | U |
| 91-20-3 | Naphthalene | 100 | U |
| 106-47-8 | 4-Chloroaniline | 100 | U |
| 87-68-3 | Hexachlorobutadiene | 100 | U |
| 59-50-7 | 4-Chloro-3-Methylphenol | 100 | U |
| 91-57-6 | 2-Methylnaphthalene | 100 | U |
| 77-47-4 | Hexachlorocyclopentadiene | 100 | U |
| 88-06-2 | 2,4,6-Trichlorophenol | 100 | U |
| 95-95-4 | 2,4,5-Trichlorophenol | 500 | U |
| 91-58-7 | 2-Chloronaphthalene | 100 | U |
| 88-74-4 | 2-Nitroaniline | 500 | U |
| 131-11-3 | Dimethyl Phthalate | 100 | U |
| 208-96-8 | Acenaphthylene | 100 | U |
| 606-20-2 | 2,6-Dinitrotoluene | 100 | U |

# 1C
# SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MLA589

Lab Name: ITAS-KNOXVILLE Contract: 29690

Lab Code: ITMWL Case No.: MS00181 SAS No.: NA SDG No.: 35625

Matrix: (soil/water) WATER Lab Sample ID: MM0346

Sample wt/vol: 100 (g/mL) ML Lab File ID: MM0346

Level: (low/med) LOW Date Received: 09/23/89

% Moisture: not dec. ____ dec. ____ Date Extracted: 09/28/89

Extraction: (SepF/Cont/Sonc) SEPF Date Analyzed: 10/11/89

GPC Cleanup: (Y/N) N pH: 6.0 Dilution Factor: 1.0

| CAS NO. | COMPOUND | CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L | Q |
|---|---|---|---|
| 99-09-2 | 3-Nitroaniline | 500 | U |
| 83-32-9 | Acenaphthene | 100 | U |
| 51-28-5 | 2,4-Dinitrophenol | 500 | U |
| 100-02-7 | 4-Nitrophenol | 500 | U |
| 132-64-9 | Dibenzofuran | 100 | U |
| 121-14-2 | 2,4-Dinitrotoluene | 100 | U |
| 84-66-2 | Diethylphthalate | 100 | U |
| 7005-72-3 | 4-Chlorophenyl-phenylether | 100 | U |
| 86-73-7 | Fluorene | 100 | U |
| 100-10-6 | 4-Nitroaniline | 500 | U |
| 534-52-1 | 4,6-Dinitro-2-Methylphenol | 500 | U |
| 86-30-6 | N-Nitrosodiphenylamine (1) | 25 | BJ |
| 101-55-3 | 4-Bromophenyl-phenylether | 100 | U |
| 118-74-1 | Hexachlorobenzene | 100 | U |
| 87-86-5 | Pentachlorophenol | 500 | U |
| 85-01-8 | Phenanthrene | 100 | U |
| 120-12-7 | Anthracene | 100 | U |
| 84-74-2 | Di-n-Butylphthalate | 100 | U |
| 206-44-0 | Fluoranthene | 100 | U |
| 129-00-0 | Pyrene | 100 | U |
| 85-68-7 | Butylbenzylphthalate | 100 | U |
| 91-94-1 | 3,3'-Dichlorobenzidine | 200 | U |
| 56-55-3 | Benzo(a)Anthracene | 100 | U |
| 218-01-9 | Chrysene | 100 | U |
| 117-81-7 | bis(2-Ethylhexyl)Phthalate | 100 | U |
| 117-84-0 | Di-n-Octyl Phthalate | 100 | U |
| 205-99-2 | Benzo(b)Fluoranthene | 100 | U |
| 207-08-9 | Benzo(k)Fluoranthene | 100 | U |
| 50-32-8 | Benzo(a)Pyrene | 100 | U |
| 193-39-5 | Indeno(1,2,3-cd)Pyrene | 100 | U |
| 53-70-3 | Dibenz(a,h)Anthracene | 100 | U |
| 191-24-2 | Benzo(g,h,i)Perylene | 100 | U |

(1) - Cannot be separated from Diphenylamine

1F
# SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
## TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

MLA589

Lab Name: ITAS-KNOXVILLE Contract: 29690

Lab Code: ITMWL Case No.: MS00181 SAS No.: NA SDG No.: 35625

Matrix: (soil/water) WATER Lab Sample ID: MM0346

Sample wt/vol: 100 (g/mL) ML Lab File ID: MM0346

Level: (low/med) LOW Date Received: 09/23/89

% Moisture: not dec. ____ dec. ____ Date Extracted: 09/28/89

Extraction: (SepF/Cont/Sonc) SEPF Date Analyzed: 10/11/89

GPC Cleanup: (Y/N) N pH: 6.0 Dilution Factor: 1.0

Number TICs found: 17

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

| CAS NUMBER | COMPOUND NAME | RT | EST. CONC. | Q |
|---|---|---|---|---|
| 1. 108-10-1 | 2-PENTANONE, 4-METHYL- | 1.87 | 470 | AJ |
| 2. 108-11-2 | 2-PENTANOL, 4-METHYL- | 2.07 | 320 | AJ |
| 3. 108-11-2 | 2-PENTANOL, 4-METHYL- | 2.18 | 4600 | AJ |
| 4. 589-38-8 | 3-HEXANONE | 2.67 | 250 | J |
| 5. 3615-37-0 | D-GALACTOSE, 6-DEOXY- | 2.73 | 380 | J |
| 6. | UNKNOWN | 2.92 | 1400 | J |
| 7. 109-08-0 | PYRAZINE, METHYL- | 3.38 | 190 | J |
| 8. 123-42-2 | 2-PENTANONE, 4-HYDROXY-4-MET | 3.70 | 390 | AJ |
| 9. 1757-42-2 | CYCLOPENTANONE, 3-METHYL- | 3.83 | 110 | J |
| 10. 2426-08-6 | OXIRANE, (BUTOXYMETHYL)- | 4.87 | 1200 | J |
| 11. 29686-12-2 | PENTANAMIDE, 5-HYDROXY- | 5.02 | 240 | J |
| 12. 541-35-5 | BUTANAMIDE | 5.50 | 110 | J |
| 13. 2426-08-6 | OXIRANE, (BUTOXYMETHYL)- | 6.67 | 430 | J |
| 14. 695-98-7 | PYRIDINE, 2,3,5-TRIMETHYL- | 8.03 | 440 | J |
| 15. 112-34-5 | ETHANOL, 2-(2-BUTOXYETHOXY)- | 9.60 | 630 | J |
| 16. 2426-08-6 | OXIRANE, (BUTOXYMETHYL)- | 10.99 | 120 | J |
| 17. 143-22-6 | ETHANOL, 2-[2-(2-BUTOXYETHOX | 13.54 | 210 | J |

# 1B
# SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.: MLA590

Lab Name: ITAS-KNOXVILLE Contract: 29690

Lab Code: ITMWL Case No.: MS00181 SAS No.: NA SDG No.: 35625

Matrix: (soil/water) WATER Lab Sample ID: MM0347

Sample wt/vol: 100 (g/mL) ML Lab File ID: MM0347R

Level: (low/med) LOW Date Received: 09/23/89

% Moisture: not dec. ____ dec. ____ Date Extracted: 09/28/89

Extraction: (SepF/Cont/Sonc) SEPF Date Analyzed: 10/12/89

GPC Cleanup: (Y/N) N pH: 6.0 Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

| CAS NO. | COMPOUND | CONCENTRATION | Q |
|---|---|---|---|
| 108-95-2 | Phenol | 100 | U |
| 111-44-4 | bis(2-Chloroethyl)Ether | 100 | U |
| 95-57-8 | 2-Chlorophenol | 41 | J |
| 541-73-1 | 1,3-Dichlorobenzene | 100 | U |
| 106-46-7 | 1,4-Dichlorobenzene | 100 | U |
| 100-51-6 | Benzyl Alcohol | 28 | J |
| 95-50-1 | 1,2-Dichlorobenzene | 100 | U |
| 95-48-7 | 2-Methylphenol | 100 | U |
| 39638-32-9 | bis(2-Chloroisopropyl)Ether | 100 | U |
| 106-44-5 | 4-Methylphenol | 100 | U |
| 621-64-7 | N-Nitroso-Di-n-Propylamine | 100 | U |
| 67-72-1 | Hexachloroethane | 100 | U |
| 98-95-3 | Nitrobenzene | 100 | U |
| 78-59-1 | Isophorone | 100 | U |
| 88-75-5 | 2-Nitrophenol | 100 | U |
| 105-67-9 | 2,4-Dimethylphenol | 100 | U |
| 65-85-0 | Benzoic Acid | 140 | J |
| 111-91-1 | bis(2-Chloroethoxy)Methane | 100 | U |
| 120-83-2 | 2,4-Dichlorophenol | 6800 | E |
| 120-82-1 | 1,2,4-Trichlorobenzene | 100 | U |
| 91-20-3 | Naphthalene | 180 | |
| 106-47-8 | 4-Chloroaniline | 100 | U |
| 87-68-3 | Hexachlorobutadiene | 100 | U |
| 59-50-7 | 4-Chloro-3-Methylphenol | 100 | U |
| 91-57-6 | 2-Methylnaphthalene | 260 | |
| 77-47-4 | Hexachlorocyclopentadiene | 100 | U |
| 88-06-2 | 2,4,6-Trichlorophenol | 50 | J |
| 95-95-4 | 2,4,5-Trichlorophenol | 500 | U |
| 91-58-7 | 2-Chloronaphthalene | 100 | U |
| 88-74-4 | 2-Nitroaniline | 500 | U |
| 131-11-3 | Dimethyl Phthalate | 100 | U |
| 208-96-8 | Acenaphthylene | 30 | J |
| 606-20-2 | 2,6-Dinitrotoluene | 100 | U |

EPA SAMPLE NO.

MLA590

1C
# SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

Lab Name: ITAS-KNOXVILLE Contract: 29690

Lab Code: ITMWL Case No.: MS00181 SAS No.: NA SDG No.: 35625

Matrix: (soil/water) WATER Lab Sample ID: MM0347

Sample wt/vol: 100 (g/mL) ML Lab File ID: MM0347R

Level: (low/med) LOW Date Received: 09/23/89

% Moisture: not dec. ____ dec. ____ Date Extracted: 09/28/89

Extraction: (SepF/Cont/Sonc) SEPF Date Analyzed: 10/12/89

GPC Cleanup: (Y/N) N pH: 6.0 Dilution Factor: 1.0

| CAS NO. | COMPOUND | CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L | Q |
|---|---|---|---|
| 99-09-2 | 3-Nitroaniline | 500 | U |
| 83-32-9 | Acenaphthene | 100 | U |
| 51-28-5 | 2,4-Dinitrophenol | 500 | U |
| 100-02-7 | 4-Nitrophenol | 500 | U |
| 132-64-9 | Dibenzofuran | 100 | U |
| 121-14-2 | 2,4-Dinitrotoluene | 100 | U |
| 84-66-2 | Diethylphthalate | 100 | U |
| 7005-72-3 | 4-Chlorophenyl-phenylether | 100 | U |
| 86-73-7 | Fluorene | 47 | J |
| 100-10-6 | 4-Nitroaniline | 500 | U |
| 534-52-1 | 4,6-Dinitro-2-Methylphenol | 500 | U |
| 86-30-6 | N-Nitrosodiphenylamine (1) | 100 | U |
| 101-55-3 | 4-Bromophenyl-phenylether | 100 | U |
| 118-74-1 | Hexachlorobenzene | 100 | U |
| 87-86-5 | Pentachlorophenol | 500 | U |
| 85-01-8 | Phenanthrene | 100 | U |
| 120-12-7 | Anthracene | 40 | J |
| 84-74-2 | Di-n-Butylphthalate | 100 | U |
| 206-44-0 | Fluoranthene | 100 | U |
| 129-00-0 | Pyrene | 100 | U |
| 85-68-7 | Butylbenzylphthalate | 100 | U |
| 91-94-1 | 3,3'-Dichlorobenzidine | 200 | U |
| 56-55-3 | Benzo(a)Anthracene | 100 | U |
| 218-01-9 | Chrysene | 100 | U |
| 117-81-7 | bis(2-Ethylhexyl)Phthalate | 100 | U |
| 117-84-0 | Di-n-Octyl Phthalate | 100 | U |
| 205-99-2 | Benzo(b)Fluoranthene | 100 | U |
| 207-08-9 | Benzo(k)Fluoranthene | 100 | U |
| 50-32-8 | Benzo(a)Pyrene | 100 | U |
| 193-39-5 | Indeno(1,2,3-cd)Pyrene | 100 | U |
| 53-70-3 | Dibenz(a,h)Anthracene | 100 | U |
| 191-24-2 | Benzo(g,h,i)Perylene | 100 | U |

(1) - Cannot be separated from Diphenylamine

EPA SAMPLE NO.

MLA590

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

Lab Name: ITAS-KNOXVILLE Contract: 29690

Lab Code: ITMWL Case No.: MS00181 SAS No.: NA SDG No.: 35625

Matrix: (soil/water) WATER Lab Sample ID: MM0347

Sample wt/vol: 100 (g/mL) ML Lab File ID: MM0347R

Level: (low/med) LOW Date Received: 09/23/89

% Moisture: not dec. ____ dec. ____ Date Extracted: 09/28/89

Extraction: (SepF/Cont/Sonc) SEPF Date Analyzed: 10/12/89

GPC Cleanup: (Y/N) N pH: 6.0 Dilution Factor: 1.0

Number TICs found: 20

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

| CAS NUMBER | COMPOUND NAME | RT | EST. CONC. | Q |
|---|---|---|---|---|
| 1. | UNKNOWN | 6.42 | 16000 | J |
| 2. 55170-80-4 | 1-DECENE, 2,4-DIMETHYL- | 7.10 | 14000 | J |
| 3. 149-57-5 | HEXANOIC ACID, 2-ETHYL- | 8.05 | 1100 | J |
| 4. 149-57-5 | HEXANOIC ACID, 2-ETHYL- | 8.70 | 880 | J |
| 5. 87-65-0 | PHENOL, 2,6-DICHLORO- | 9.99 | 390 | J |
| 6. 61142-78-7 | 1-DECENE, 9-METHYL- | 10.75 | 350 | J |
| 7. 54518-15-9 | BENZENE, DICHLOROMETHOXY- | 11.10 | 510 | J |
| 8. | UNKNOWN | 13.84 | 1400 | J |
| 9. 933-78-8 | PHENOL, 2,3,5-TRICHLORO- | 13.92 | 3700 | J |
| 10. 6597-78-0 | DISUGRAN (ACN) | 14.39 | 420 | J |
| 11. | UNKNOWN | 14.75 | 5400 | J |
| 12. | UNKNOWN | 14.84 | 570 | J |
| 13. 1928-38-7 | 2,4-D METHYL ESTER | 15.30 | 370 | J |
| 14. 1928-38-7 | 2,4-D METHYL ESTER | 15.75 | 2100 | J |
| 15. 1918-00-9 | BENZOIC ACID, 3,6-DICHLORO-2 | 16.20 | 6600 | J |
| 16. 94-74-6 | ACETIC ACID, (4-CHLORO-2-MET | 16.32 | 2500 | J |
| 17. 94-75-7 | ACETIC ACID, (2,4-DICHLOROPH | 16.54 | 6500 | J |
| 18. 94-75-7 | ACETIC ACID, (2,4-DICHLOROPH | 17.32 | 9300 | J |
| 19. 1918-02-1 | 2-PYRIDINECARBOXYLIC ACID, 4 | 20.92 | 620 | J |
| 20. 25168-26-7 | ACETIC ACID, (2,4-DICHLOROPH | 21.20 | 430 | J |

**APPENDIX B**

**FIELD PROCEDURES**

From the RUST Geotech Inc.
*Environmental Procedures Catalog,* Manual 116

# Standard Practice for Field Documentation Processes

## 1. Scope

1.1 This standard practice covers reproducibility, legibility, accuracy, completeness, protection, identification, and error correction of records. The practice describes the control, data entry, content, review, and storage of field documents such as logbooks, field notebooks, data sheets, and other records.

## 2. Hazard Analysis

2.1 No hazards requiring controls have been identified. Site-specific controls are available in the Health and Safety Plan for a particular project.

## 3. Referenced Documents

3.1 Geotech, *Management Policies Manual* (Manual 100), Section 13, "Records Management."

3.2 Geotech, *Quality Assurance Manual* (Manual 101), Criterion 17, "Records."

3.3 U.S. Environmental Protection Agency, *SW-846, Test Methods for Evaluating Solid Waste, Vol. II, Field Manual, Physical/Chemical Methods,* Office of Solid Waste and Emergency Response, November 1986, 3rd Edition.

## 4. Terminology

4.1 *Records*—Information or data on a specific subject collected and preserved in writing or other permanent form that have been verified and authenticated as technically complete and correct. Records may include data sheets, logbooks, field notebooks, maps, drawings, photographs, and electronic data-recording media.

4.2 *Technical record books*—For purposes of this practice, technical record books will refer to logbooks and field notebooks.

## 5. Significance and Use

5.1 This practice will be used to document results of tasks performed using the *Environmental Procedures Catalog,* unless the project Work Plan provides an alternate practice.

5.2 This practice includes the use of technical record books for direct data entry or as journals referring to the location of associated supporting documents for activities.

5.3 Documentation of the results produced from performing tasks is necessary to provide adequate evidence of compliance with requirements, provide an adequate basis for design decisions, and document techniques and conditions of sample collection.

## 6. General Procedures for Records

6.1 All records produced from work performed according to procedures in the *Environmental Procedures Catalog* must meet the following requirements:

6.1.1 Records must clearly describe the work performed. Enough detail must be provided to enable someone of equivalent skill and experience in the technology to repeat the work as originally performed.

6.1.2 Records must be clear, legible, and reproducible. Black ink is preferred. Reproducible photocopies of penciled documents are acceptable as records.

6.1.3 Errors will be corrected by lining through the incorrect entry with a single line, making the correction, and initialing and dating the correction. The erroneous information must not be obliterated or erased.

6.1.4 Records must specify the activity conducted, the program sponsor, and the method used, if applicable. The signature of the person who performed the work and the date it was performed must appear on each page of a record and on any attached sheets. (Initials are acceptable if an initials' log identifies the person.)

6.1.5 For short-term tasks, the Work Plan will define the records to be maintained for each task conducted and the disposition of the records. The following are suggested records of a short-term task:

6.1.5.1 Operational check data.

6.1.5.2 Data sheets.

6.1.5.3 Technical record books.

6.1.5.4 Official correspondence.

6.1.5.5 Planning documents.

6.1.5.6 Electronically or magnetically stored data.

6.1.6 For ongoing programs, a Records Management Plan defines what records will be generated, how long they will be retained, and the disposition of the records (see reference 3.1).

6.1.7 Records must be protected against damage, deterioration, and loss while in the field, during data review, and until they are submitted to a storage facility. Records must be isolated from any source of contamination.

6.1.8 An independent reviewer will review data sheets or data contained in technical record books, as well as electronic data collection and data entry, as described in section 7.5.

6.1.9 All data will be reviewed before personnel leave a remote site. The review will ensure that no additional sampling or data acquisition is required before departure.

6.1.10 When the procedure specifies compilation of data sheets, the data must be legible and traceable to the activity, project, and method used. The person completing the data sheet will sign and date the sheet and ensure that applicable spaces are completed.

## 7. Procedures for Technical Record Books

7.1 Technical record books will be bound books with sequentially numbered pages. Each book will be given a unique identifier.

7.2 *Issue and Control of Technical Record Books*—A technical record book will be assigned to an activity or a person for use on a project. The technical record book will be transmitted to the Project Manager or designee upon completion. If a technical record book contains information on more than one activity or project, the technical record book will clearly identify the portion associated with each activity or project. Reproducible copies of applicable sections of these books may be submitted to the Project Manager or designee as records.

7.2.1 The Project Manager shall determine the following and make a written record of the decisions:

7.2.1.1 Who will issue technical record books.

7.2.1.2 The number of each technical record book and the person to whom the book is issued.

7.2.1.3 The expected location for each technical record book when not in use (building and room number).

7.2.1.4 The reviewer of each technical record book and the frequency of reviews.

7.2.1.5 Whether support organizations are to use technical record books dedicated to the project or whether they will be required to furnish copies of applicable pages from technical record books supporting several projects.

7.2.2 The person to whom a technical record book is issued shall take the following steps upon receipt of a new technical record book:

7.2.2.1 Review general information on maintenance of the technical record book.

7.2.2.2 Complete the information block (if any) on the first sheet inside the front cover.

7.2.2.3 Identify the technical record book by entering the project number and title and the applicable task or subtask numbers as appropriate.

7.2.2.4 Determine whether to reserve specific pages for a Table of Contents and for the names of people who make entries and who will review the technical record book.

7.2.2.5 The first entry in the book shall describe the work covered and, as appropriate, the name of the sponsor, the Work Order or Statement of Work number, and the objectives of the work.

7.2.2.6 Prepare and maintain a list of the printed name, written signature, and initials used by each person who is authorized to make entries, including review entries.

7.3 *Rules for Data Entry*

7.3.1 Pages shall be kept intact. No page is to be left completely blank or removed from the book.

7.3.2 Use pages consecutively. If a page has entries from more than 1 day, each entry shall be signed and dated. If a page or part of a page must be left blank, it must be ruled across, signed, and dated. If entries for a given subject are made on two or more pages that are not consecutive, each page must be cross referenced to the previous and following entries.

7.3.3 Record all data as required by procedures for the activity being performed. Enter all data directly in a technical record book when practical. If loose sheets, such as test data sheets, photocopies, or photographs must be added to a technical record book, proceed as follows:

7.3.3.1 Glue, tape, or staple each sheet or part of a sheet to the next blank page or blank space, according to the amount of space needed.

7.3.3.2 Enter on the page of the technical record book a description of the material that is attached, and enter on each attachment the technical record book number and page number. This information will allow identification of the attachment if it comes loose.

7.3.4 Describe or reference in the technical record book any other permanent written or visual records generated for the project and not readily available in the open literature or that cannot be directly inserted because of size or bulk (e.g., data sheets, computer printouts, films, or magnetic media). Any project records that are cited must be filed and controlled as records. Records that are readily available in the open literature need only be referenced. The purpose is to provide a clear, complete record of activities and supporting documents.

7.3.5 The last entry in a technical record book shall be either a statement that the work was concluded or a reference to a sequential technical record book.

7.4 *Content of Technical Record Books*—The following information may be entered in technical record books, as applicable:

7.4.1 Table of Contents, consisting of pages with continuing entries.

7.4.2 What work was done and how it was done, including such information as a description of the facility, test design, measuring and test equipment (by serial number), and a reference by number and title to any standard procedure used.

7.4.3 Instrument numbers or equipment used, if not specified in a referenced procedure.

7.4.4 Field checks or calibrations that are not documented elsewhere.

7.4.5 Identification of personnel and responsibilities or duties of each person.

7.4.6 Why the work was done, including any Statement of Work under which the work was done and with what objective.

7.4.7 What results were obtained. Observations made, the review of the results, and nonconformances and deficiency reports may be included.

7.4.8 Temperature, weather, humidity, wind speed and direction, or other environmental influences that might affect the results.

7.4.9 Documentation of variances from planned activities. A variance is considered to be a deviation from "shall," "must," or "will" statements of a procedure.

7.4.10 Location of the activity, including site and sample or test location.

7.4.11 Name and address of field contact.

7.4.12 Sampling entries:

7.4.12.1 Purpose of sampling.

7.4.12.2 Description of sampling point and sampling methodology.

7.4.12.3 Number of samples taken and volume.

7.4.12.4 Date and time of sample collection.

7.4.12.5 Sample destination (name of laboratory) and how transported (hand carried or name of carrier, such as United Parcel Service or Federal Express).

7.4.12.6 References such as maps or photographs of the sampling site.

7.4.13 Entries relating to waste:

7.4.13.1 Producer of waste and address, if different for that location.

7.4.13.2 Type of process (if known) that produced the waste.

7.4.13.3 Type of waste (e.g., sludge, wastewater).

7.4.13.4 Suspected composition and concentrations of waste.

7.4.14 Other appropriate entries such as calculations, problems encountered and actions taken to resolve them, or interfaces with agencies.

7.5 *Review of Technical Record Books*—An independent reviewer will review technical record books for content, accuracy, legibility, calculations, error correction, and reproducibility (see reference 3.2).

7.5.1 A reviewer will review electronic data collection or data entry for correctness and accuracy by comparison of originals with printed data or by review of the graphic representation of the data.

7.5.2 The reviewer will check for completeness, validity of data, and traceability between each page and the items or activities to which it applies. The reviewer will take action to correct any deficiencies.

7.5.3 When the reviewer is satisfied that the information recorded is complete and correct, the reviewer will sign and date the technical record book and indicate the pages and supporting documents that were reviewed.

7.5.4 Written comments by a reviewer that are clearly identified as review comments will not require review by a second reviewer.

7.6 *Storage of Technical Record Books*—Technical record books shall be stored in fire-resistant metal file cabinets or otherwise protected from damage when not directly in use. Records shall not be left unprotected overnight or on holidays, vacations, or weekends (see reference 3.2).

## 8. Keywords

8.1 Data sheets, documentation, field documentation, field notebooks, logbooks, records, and technical record books.

# Standard Practice for Sample Labeling

## 1. Scope

1.1 This procedure covers labeling requirements and recommended practices for labeling samples that are collected in the field and intended for analysis at a later time. The types of samples covered include, but are not limited to, solids such as soils and cores, liquids and sludges, gases, filters, and wipes. This procedure is intended for use on samples collected using a variety of methods including grab samples, composite samples, duplicate samples, and split samples.

1.2 Programs or functional groups may develop other labeling procedures if required, but they must reference such procedures in their Work Plans or other project documentation. Alternate procedures shall include the minimum information listed in Section 5.2 of this procedure.

## 2. Hazard Analysis

2.1 No hazards requiring controls have been identified. Site-specific controls are available in the Health and Safety Plan for a particular site.

## 3. Referenced Documents

3.1 Geotech *Environmental Procedures Catalog* (Manual 116):

- Standard Practice for Field Documentation Processes [GN-3(P)].
- Standard Practice for Chain-of-Sample-Custody Control and Physical Security of Samples [GN-9(P)].

## 4. Terminology

4.1 *Sample* (n)—a portion of material taken as representative of a larger mass.

4.2 *Sample* (v) —to select and collect a sample.

4.3 *Sample label*—the documentation attached to the sample or sample container and marked with required information about the sample. An example is shown in Figure 1.

4.4 *Sample log*—a document listing one or more samples collected during a field visit or visits.

4.5 *Field*—any place where the material for analyses or testing is collected.

Geotech, Inc.

Chem-Nuclear Geotech, Inc.
P.O. Box 14000
2597 B 3/4 Road
Grand Junction, Colorado 81502-5504
303/248-6000

Sample No. ______________ Date ______________

Sampler ______________ Time ______________

Project Site ______________ Location ______________

Sample Type ______________

Comment ______________

______________

*Figure 1. Example of Sample Label*

4.6 *Sample number*—the unique number assigned by Geotech to each sample and attached to or written on the sample label or sample. The sample number will normally consist of three alpha and three numeric characters and will have both eye-readable and bar-code portions (see Figure 2.)

NAA095

*Figure 2. Example of a Sample Number*

4.7 *Multiple sample*—multiple samples taken from the same source but placed in separate containers.

4.8 *Split*—a sample that has been subdivided into two or more parts.

4.9 *Chain-of-custody record*—a form used to document sample custody and receipt. It may also contain other information, such as sample identification and traceability.

## 5. Summary of Practice

5.1 All samples collected by Geotech personnel shall have a sample label and a unique Geotech-generated sample number attached to, or written on, the sample or sample container.

5.2. The minimum information written on the sample label shall include

5.2.1 Sample number,

5.2.2 Identity of sampler,

5.2.3 Date sample was collected, and

5.2.4 Project site.

5.3 Additional information may also be written on the label.

5.4 Sampling personnel shall use a field sample log, chain-of-custody form, or both to record the sample numbers and other pertinent information for a sample or group of samples. See Standard Practice for Chain-of-Sample-Custody Control and Physical Security of Samples [GN–9(P)] and Standard Practice for Field Documentation Processes [GN–3(P)].

5.5 Sampling personnel shall use reproducible, waterproof ink to write all information on the label or log.

## 6. Significance and Use

6.1 All Geotech personnel shall use this procedure for sample identification unless an approved alternate procedure is included or referenced in the official project records. Alternate procedures shall include the minimum information identified in Section 5.2.

6.2 This procedure does not address labeling practices for any in situ measurements or sampling techniques.

## 7. Materials

7.1 Preprinted Geotech sample labels with adhesive backing,

7.2 Preprinted sample numbers with adhesive backing,

7.3 Pen with reproducible, waterproof ink,

7.4 Clear protective tape (normally 2 inches wide), and

7.5 Sample log, chain-of-custody form, or both.

## 8. Procedure

8.1 The Geotech Field Assessments clerical staff shall maintain a supply of preprinted, adhesive-backed sample labels and sample numbers.

8.2 The Field Assessments clerical staff shall maintain a log as a record of the sample labels and numbers issued, requester's name, and date of issue.

8.3 The sample label may be completed before or after attachment to the sample container. If labels are not available, the required information may be written directly onto the sample or sample container.

8.4 Use waterproof, reproducible ink to complete the required label information.

8.5 Normally, the sampler will complete the entire label. If some of the requested information is not relevant, the sampler shall designate that space as "NA" for "Not Applicable."

8.6 An example of the information required on the label is shown in Figure 1. Section 5.2 of this procedure specifies the minimum information required.

8.6.1 *Sample Number*—The unique number Geotech assigns to each sample. Normally, the sample number will consist of three alpha and three numeric characters with eye-readable and bar-code portions.

8.6.2 *Date*—The date the sample was collected.

8.6.3 *Sampler*—The name or initials of the person who collected the sample.

8.6.4 *Time*—The time at which the sample was collected.

8.6.5 *Location*—The location where the sample was collected. Examples of locations include well numbers, grid locations, or surveyed coordinates.

8.6.6 *Sample Type*—One or more terms that describe the type of sample. This description may cover sample material such as soil, water, sludge, air, or core. It may also include the product of a sampling method such as composite, grab, or wipe sampling.

8.6.7 *Project Site*—The area or property defined in project documents containing one or more sample locations.

8.7 Attach the preprinted sample number to the sample label. The sample number consists of a bar code and an eye-readable number. If the preprinted number is spoiled or does not adhere to the label, the sampler may write the sample number on the sample, sample label, or sample container.

8.7.1 If multiple samples are taken at the same location or if splits of a sample are made in the field, the sampler shall identify the sample by writing the sample number on the sample label or by attaching a preprinted label. The sample number shall be identical for each sample in the entire group of duplicates or splits.

8.7.2 Multiple samples or sample splits may also be assigned a unique sample number for purposes of documenting the precision of the sampling and analytical process. These samples are commonly referred to as "blind duplicates" or "field duplicates."

8.7.3 Obtain preprinted labels with duplicate numbers from the Field Assessments clerical staff. One week's notice may be required for printing of series labels with more than five multiples of the same number.

8.7.4 All multiple numbers shall be printed on colored label stock to distinguish between single-series numbers (white stock ) and multiple-series numbers.

8.7.5 Care should be taken in the field to discard any unused multiple numbers.

8.8 Protect the completed sample labels from moisture and abrasion by placing a piece of clear plastic tape over the label.

8.9 Maintain a record of sample numbers and other pertinent information on a sample log, chain-of-custody form, or both.

## 9. Keywords

9.1 Samples, labels, and sample labeling.

# Standard Practice for Chain-of-Sample-Custody Control and Physical Security of Samples

## 1. Scope

1.1 This procedure describes the documentation required for tracing sample custody and the requirements for physical security of samples.

1.2 Programs or functional groups may develop other documents and procedures for sample custody records but shall reference such documents and procedures in their Work Plans or other project documents.

1.3 Projects that do not require sample custody documentation may use other methods such as sample logs for documenting sample information.

1.4 No chain-of-sample-custody control is required for samples when the only analyses are performed in situ.

## 2. Hazard Analysis

2.1 No hazards requiring controls have been identified. Site-specific controls are available in the Health and Safety Plan for a particular site.

## 3. Referenced Documents

3.1 Geotech, *Environmental Procedures Catalog*, (Manual 116):

Standard Practice for Field Documentation Processes [GN–3(P)],

Standard Practice for Sample Labeling [GN–8(P)].

## 4. Terminology

4.1 *Sample* (n)—a portion of material taken as representative of a larger mass.

4.2 *Sample* (v)—to select and collect a sample.

4.3 *Split*—a portion of a sample that has been subdivided in the field.

4.4 *Sample number*—the unique number authorized and tracked by Field Assessments and printed by Records Mangement. Each sample number is attached or written on the sample or sample label. The sample number will normally consist of three alpha and three numeric characters and will have both eye-readable and bar-code portions.

4.5 *Custody*—to have in sight, immediate possession, or locked under your personal control.

4.6 *Chain-of-sample-custody record*—a form such as the Chain of Sample Custody (GJPO 1512), or equivalent, used to document information on sample custody and receipt of sample.

4.7 *Subcontract laboratory*—any laboratory other than the Geotech Analytical Laboratory at the Grand Junction Projects Office (GJPO) to which samples are sent for analysis.

4.8 *In situ*—in place, not removed from the point of original deposition.

4.9 *Duplicate samples*—multiple samples taken from the same source but placed in separate containers.

4.10 *Custody seals*—adhesive-backed strips fastened to the sample container or the shipping container in such a way that they demonstrate that no tampering with the samples has occurred. Custody seals may also be manufactured in the field by using paper strips and clear plastic tape.

4.11 *Custody tags*—metal or plastic tags fastened to the sample container or the shipping container in such a way as to demonstrate that no tampering with the sample has occurred.

4.12 *Physical security*—synonymous with custody but emphasizes the measures taken to prevent tampering with the samples or sampling process.

## 5. Summary of Practice

5.1 The sampler will take appropriate actions to provide for physical security of the samples and sampling process.

5.2 The sampler will generate a chain-of-custody record, such as the form shown in Figure 1, during or after sample collection. General instructions for completing the form are on the back of the form (see Figure 2).

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**Chain of Sample Custody**

1. Page____ of____
2. Date__________

3. Project Name ______________________________
4. Site Location ______________________________
5. Sampler *(print name)* ______________________________

| 6. Sample No. | 7. Date | 8. Time | 9. Sample Location | 10. Sample Matrix | 11. Containers | | | | | | 12. Remarks | 13. Condition Received |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| 14. Relinquished by *(signature)* | Date | Time | Relinquished by *(signature)* | Date | Time | Relinquished by *(signature)* | Date | Time |
|---|---|---|---|---|---|---|---|---|
| Received by *(signature)* | Date | Time | Received by *(signature)* | Date | Time | Received by *(signature)* | Date | Time |

| 15. Method of Shipment | 16. Laboratory/Destination | 17. Airbill or Receipt Number |
|---|---|---|
| | | |

18. For Contract Laboratories Only—Receiver to sign, date, and return form by mail or with analytical data package

Company Name ______________________ Received by ______________________ Date __________

Preparation instructions on back of form.

Distribution: Original accompanies shipment, copies to relinquisher.

*Figure 1. Chain of Sample Custody, GJPO 1512*

5.3 The current version of GJPO 1512 shall be used unless a project specifies a different form or specifies that no chain of custody is required.

5.4 The minimum information required to ensure sample identification is

5.4.1 Project name,

5.4.2 Sample number,

5.4.3 Date chain-of-custody record was prepared, and

5.4.4 Sampler's signature.

5.5 The sampler shall complete all information blocks or label the blocks as "NA" for "Not Applicable." Unused portions of the form must be lined through with a single line, initialed, and dated (see Figure 3).

5.6 Before shipment by a non-Geotech transporter, custody seals or tags shall be fastened to the individual sample container or to the shipping container. The custody seals or tags shall be completed with the date the samples were sealed and the signature of the sealer.

5.7 The original chain-of-custody record shall accompany the samples until receipt by the Geotech Analytical Laboratory or other laboratory.

5.8 When custody of the samples is transferred from one person to another, or from a person to another organization, the relinquisher shall sign the appropriate block and retain a copy of the form. Non-Geotech employees are not required to sign the form.

## 6. Significance and Use

6.1 All Geotech personnel shall use this procedure for chain-of-sample-custody control and physical security unless an approved alternate procedure is included or cited in the official project documents.

**Chain of Sample Custody**

1. **Page_____of_____:** Indicates sequence and total number of pages.
2. **Date:** Date the chain-of-custody record was prepared.
3. **Project Name:** The project name or title.
4. **Site Location:** The location of the project site.
5. **Sampler:** The printed name of the person who collected the samples.
6. **Sample No.:** The unique three-letter, three-digit number generated by Geotech.
7. **Date:** Date the sample was collected.
8. **Time:** The time the sample was collected.
9. **Sample Location:** The location at which the sample was taken; e.g., well number, grid location, or survey coordinate.
10. **Sample Matrix:** The sample matrix, e.g., soil, sludge, water, air, or filter.
11. **Container:** The type of container, e.g., write 40-ml glass in the slanted column. Write the number of containers of a given type on the corresponding horizontal line.
12. **Remarks:** Any remarks, as appropriate; preservation method required, e.g., acidified < 2 pH.
13. **Condition Received:** For use by laboratory personnel, to note any damage to sample or container.
14. **Relinquished by/Received by:** Signatures of relinquishers and receivers, with date and time of sample transfer.
15. **Method of Shipment:** The method of shipment, e.g., Federal Express, bus line, etc.
16. **Laboratory/Destination:** The place the samples were shipped for analysis, storage, or other purposes.
17. **Airbill or Receipt Number:** For use with airbills or receipts from contract shippers.
18. **For Use by Contract Laboratories Only:** For use by laboratories other than the Geotech Analytical Laboratory of the Grand Junction Projects Office (GJPO). Receiver to sign, date, and return this form to Geotech by mail or with analytical data package.

**General:** The purpose of this form is to document sample custody and receipt. Geotech/GJPO assumes no responsibility for samples not in the custody of Geotech personnel.

The users of this form are responsible for completing the form by using a waterproof, reproducible ink.

The users of this form are responsible for legibility of all entries.

All information blocks must be completed or marked as "NA" for "Not Applicable." Unused portions of the form must be lined out with a single line, initialed, and dated.

*Figure 2. Instructions for Completing Chain of Sample Custody (reverse side of GJPO 1512)*

## 7. Materials

7.1 GJPO 1512, Chain of Sample Custody or equivalent.

7.2 Ballpoint pen with reproducible, waterproof ink.

7.3 Custody seals or tags.

7.4 Padlocks, receptacles, containers, and enclosures as appropriate to provide physical security of the samples and sampling process.

## 8. Chain-of-Sample Custody Procedure

8.1 GJPO 1512, Chain of Sample Custody, is a four-part no-carbon-required (NCR) form available as a Geotech Stores issue item.

8.2 The following items provide additional information on some of the instructions that are on the back of GJPO 1512 (see Figure 2).

8.2.1 "Sample No." is the unique number assigned by Geotech to each sample and written on or attached to the sample label, sample container, or the sample. Normally this is a three-letter, three-digit number. See Standard Practice for Sample Labeling [GN–8(P)].

8.2.2 "Container" specifies the type of container in the slanted column. The number of containers of a given type is entered on the horizontal line below the slanted column.

8.2.2.1 Preservation method may be specified with container type.

8.2.3 "Condition Received" is the condition of the individual sample when received (normally by the analytical laboratory). Examples could include broken container, lid off, leaking fluid, etc.

8.2.4 "Relinquished by/Received by" is for the signatures of relinquishers and receivers. The relinquishers, by signing, verify that the samples have been within their custody. It is each signatory's responsibility to write the signature legibly.

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**Chain of Sample Custody**

1. Page 1 of 1
2. Date 2/11/91
3. Project Name SFMP
4. Site Location Monticello Utah
5. Sampler (print name) [illegible signature]

| 6. Sample No. | 7. Date | 8. Time | 9. Sample Location | 10. Sample Matrix | 11. Containers: 1 L plastic | 125 ml plastic | 1 L glass | .5 L glass | 40 ml glass | | 12. Remarks | 13. Condition Received |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAA 001 | 2-11-91 | 13.00 | Well 5A | water | 3 | | | | | | Ra 226 pH<2 HNO3 Filtered | ok |
| ↓ | ↓ | ↓ | ↓ | ↓ | | 1 | | | | | metals pH<2 HNO3 unfiltered | ↓ |
| | | | | | | | 3 | | | | PCB unfiltered cool | |
| | | | | | | | | 1 | | | BOD, cool | |
| | | | | | | | | | 2 | | VOL, pH<2 HCl cool | |
| | | | | | | | | | | | | |
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| 14. Relinquished by (signature) | Date | Time | Relinquished by (signature) | Date | Time | Relinquished by (signature) | Date | Time |
|---|---|---|---|---|---|---|---|---|
| [signature] | 2/12/91 | 1:30 pm | | | | | | |
| Received by (signature) | Date | Time | Received by (signature) | Date | Time | Received by (signature) | Date | Time |
| [signature] | 2-12-91 | 13:30 | | | | | | |

15. Method of Shipment | 16. Laboratory/Destination | 17. Airbill or Receipt Number

18. For Contract Laboratories Only—Receiver to sign, date, and return form by mail or with analytical data package

Company Name ____ Received by ____ Date ____

Preparation instructions on back of form.

Distribution: Original accompanies shipment, copies to relinquisher.

*Figure 3. Method for Indicating Unused Portion of Chain of Sample Custody Form*

8.2.5 "Laboratory/Destination" is the place to which the samples are shipped for analysis, storage, or other purposes.

8.2.6 "For Contract Laboratories Only" is for use by laboratories other than the Geotech Analytical Laboratory at the GJPO. Receiver is to sign, date, and return this form to Geotech by mail or with the analytical data package.

8.3 The sampler shall complete the chain-of-custody record, such as shown in Figure 1, during or after sample collection.

8.4 The sampler shall complete all information blocks or label the blocks as "NA" for "Not Applicable." Line through unused portions of the form with a single line, and initial and date the line (see Figure 3).

8.5 Waterproof, reproducible ink shall be used to complete the form.

8.6 When samples will be transported by a non-Geotech shipper, custody seals or tags shall be used to seal the individual sample container or the shipping carton in such a way as to demonstrate that no tampering has occurred.

8.7 The custody seals may be applied to the sample container or the inner or the outer shipping container. When seals are applied to the sample container, they must not obscure the information on the sample label. Shipping containers shall be securely wrapped or fastened prior to application of the custody seals. The seals are inherently fragile and will not withstand pressure from an inadequately packaged container. All possible access flaps or lids of the shipping container must be sealed.

8.8 The date the samples were sealed and the signature of the packager (as shown in Figure 4) shall be written with waterproof ink on the custody seals or tags. Clear plastic tape may be applied over the seals for protection.

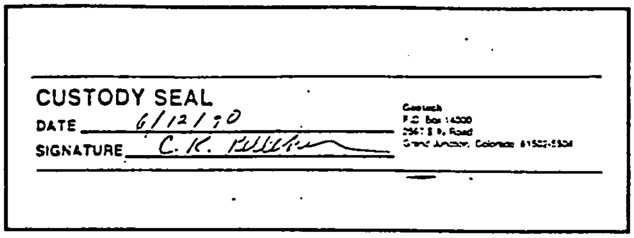


*Figure 4. Example of Custody Seal*

8.9 The original chain-of-custody record shall accompany the samples until the samples are received by the laboratory.

8.10 When the samples are physically transferred from one person to another, or from a person to a shipper, the relinquisher shall sign the appropriate block and retain a copy of the form.

8.11 Geotech personnel shall sign the "Received by" box when receiving samples. Subcontract shippers or personnel who do not work for Geotech are not required to sign when receiving samples.

8.12 Unless otherwise specified by the project, the chain-of-custody record shall be maintained as part of the project records.

8.13 The initiator of the form is responsible for legibility of all entries.

## 9.0 Physical Security of Samples and Sampling Process

9.1 The sampler must maintain physical security of the samples, sampling process, and equipment by physical possession, visual contact, or seals or locks to prevent tampering. Because the procedures for physical security are unique to each sampling situation, only guidelines can be given.

9.1.1 Lock the sampling device when unattended. For example, when using an unattended autosampler to collect samples for a period of time, the device must be locked or secured to maintain physical security.

9.1.2 Store samples in a locked storage area. For example, when collecting samples for a period of time before transport to the laboratory, lock the samples in a secure storage area or in an area with controlled access such as a locked vehicle or locked field office.

9.1.3 Use security seals where appropriate. Although security seals do not provide physical security, the seals are evidence that the samples or sampling process were not tampered with while unattended.

9.1.4 Use best professional judgment when providing physical security of the samples or sampling process. The sampler should be knowledgeable of the programmatic requirements for the samples and provide the appropriate degree of physical security.

9.2 The sampler must document in field logs, or other project documents, the type of physical security used.

## 10. Keywords

10.1 Samples, sample custody record, chain-of-sample-custody record, and forms.

# Standard Practice for Equipment Decontamination

## 1. Scope

1.1 This practice may be followed if more-specific information is not provided in individual test methods or practices. Decontamination of equipment and instruments is necessary to minimize the spread of contaminants within a site and from the site, to reduce worker exposure to potentially hazardous materials, and to prevent cross contamination of samples and ensure data quality and reliability. The degree and type of decontamination is dependent on the type of material(s) being sampled and the analytical considerations for the sample. This practice does not describe decontamination of personnel.

## 2. Hazard Analysis

2.1 Decontamination may pose hazards to individuals under certain circumstances or if care is not exercised. Personnel should consider the following observations before proceeding with decontamination procedures.

2.1.1 Decontamination methods may be incompatible with the hazardous substance(s) being removed and cause reactions that produce heat, toxic fumes, or explosions.

2.1.2 Decontamination methods may be incompatible with clothing or equipment being decontaminated; for example, organic solvents or acids may permeate and/or degrade protective clothing or equipment.

2.1.3 Decontamination methods may pose a direct hazard to workers if protection from acid rinses is not taken, or adequate and safe working conditions are not provided in the area where decontamination is conducted.

2.2 To control decontamination hazards, site investigators shall use information from the historical research of a site and shall apply common sense. The determination can be made before sampling commences if there is potential chemical and physical incompatibility of decontamination solutions with expected site contaminants and sampling equipment. Sources to contact include the Geotech Analytical Laboratory, Material Safety Data Sheets (MSDSs), and manufacturers of equipment suspected of producing deleterious reactions with cleaning solutions. The use of personal protective clothing will provide protection from acid rinses. Decontamination work areas must have adequate working space and be organized to minimize awkward or strenuous movements by workers.

## 3. Referenced Documents

3.1 Geotech, *Work Plan for Groundwater Monitoring at the DOE/Kansas City Plant*, UNC/GJ–KC–1, Grand Junction Projects Office, Grand Junction, CO, 1990.

3.2 National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Environmental Protection Agency (EPA), and U.S. Coast Guard (USCG), *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, available from EPA or the U.S. Government Printing Office, Washington, D.C., 1985.

3.3 U.S. Department of Energy, *The DOE Environmental Survey Manual*, Appendix G, Decontamination Guidance, DOE/EH–0053, 1987.

3.4 U.S. Environmental Protection Agency (EPA), *A Compendium of Superfund Field Operations Methods*, EPA/540/P–87/001.

3.5 U.S. Environmental Protection Agency, "EPA Hazardous Materials Incident Response Operations," *Environmental Response Team Training Manual*, 1985.

3.6 U.S. Environmental Protection Agency, *Personnel Protection and Safety*, available from the EPA Office of Emergency and Remedial Response Hazardous Response Support Division, Environmental Response Team, 1986.

## 4. Significance and Use

4.1 The purpose of this practice is to provide guidance for the decontamination of field tools and equipment used in the collection of soils, sludges, liquids, and gases that will be submitted for physical and chemical analyses.

4.2 Investigators will be familiar with site-specific conditions and specific sample needs before collecting samples and will use the most efficient and cost-effective decontamination procedures that are based on specific-site conditions and the purposes for the samples. Investigators may add to or modify these procedures as needs arise.

4.3 This practice is designed for use mainly with chemical wastes. Transuranic radioactive wastes, biological materials, or combinations of these materials should be considered individually for decontamination procedural design. Site investigators should consult the Geotech Health, Safety, and Security Section and Environmental Services Section for additional information.

4.4 This practice is applicable to the decontamination of most conventional sampling tools and equipment composed of metals and synthetic materials. Site managers and Field Team leaders should consult the manufacturers of any tools or equipment that may be of unusual composition for possible reactivity with cleaning methods and solutions or rinsing agents.

4.5 Consideration should be given to the use of dedicated sampling equipment if legitimate concerns exist for the production of undesirable and/or unmanageable waste byproducts during the decontamination of tools and equipment.

4.6 Decontamination methods should be used generally before, between, and after the completion of sampling events.

4.7 Personal decontamination is described in references 3.2, 3.4, and 3.6, available from the EPA. Reference 3.3 discusses decontamination of both equipment and personnel.

## 5. Terminology

5.1 *Contaminant*—An undesirable substance not normally present or an unusually high concentration of a naturally occurring substance in gas, water, or soil.

5.2 *Contaminate*—To make impure or corrupt by contact or mixture.

5.3 *Contamination*—The act of process of contaminating.

5.4 *Decontamination*—The process of removing or reducing to a known or acceptable level undesirable physical and/or chemical constituents from sampling apparatus, equipment, or personnel.

5.5 *Equipment*—Materials such as tools, gear, or provisions used to accomplish a task.

5.6 *Hazardous Material*—(1) A substance or material that has been determined by the Secretary of Transportation to be capable of imposing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated (by the U.S. Department of Energy); (2) a substance or material that is capable of posing unreasonable risks to living organisms.

5.7 *Site*—A physical location.

5.8 *Waste (as a pollutant)*—A substance or mixture that, after release into the environment and upon exposure to any organism, will or may reasonably be anticipated to cause adverse effects in such organisms or their offspring.

## 6. Procedure

6.1 *Decontamination Plan*—A site decontamination plan should be developed for each site before any personnel or equipment enter the work area. The following information should be included in the plan:

6.1.1 Number and location of decontamination stations (a map is suggested). If formal zones are established for a site, the decontamination stations should be located in the Contamination Reduction Zone, usually near the edge of the Support Zone (the clean area), if equipment is to leave the site. Otherwise, the stations may be mobile to accommodate sampling plans.

6.1.2 A list of anticipated equipment that will be needed for sampling and equipment/supplies that will be needed for decontamination.

6.1.3 A list of appropriate methods for decontamination.

6.1.4 A set of established guidelines for release of equipment and personnel (i.e., what is "clean?") that satisfy local, State, and Federal regulations.

6.1.5 Methods for determining if equipment is adequately cleaned may include the following:

6.1.5.1 Visual observation in natural light for discolorations, dirt, stains, and corrosive effects.

6.1.5.2 Visual observation in ultraviolet light for yellowish fluorescence associated with some polycyclic aromatic hydrocarbons.

6.1.5.3 Use of organic "sniffers" such as organic vapor analyzer (OVA) monitors.

6.1.5.4 Swipe-testing analysis for later verification results.

6.1.5.5 Cleaning-solution analysis for later verification results.

6.1.5.6 Testing for permeability, which requires the removal of some part of the equipment or clothing for later analysis.

6.1.4 A set of established logistics for containing any contaminated rinses and materials generated during decontamination.

6.1.5 A set of established methods for disposing of decontamination rinses and used materials.

6.2 The plan should be revised as needed to adequately provide for decontamination of new or unanticipated substances or site conditions.

6.3 The practice presents four methods for the decontamination of equipment. The methods may be used individually or in combination to achieve a higher level of decontamination. The proper method or combination of methods will depend on the type of contaminants, level of decontamination required, and purpose of decontamination. Pressurized water or steam cleaning may be appropriate to perform initial decontamination of equipment in Methods A, B, C, and D. It is strongly recommended that the person performing the decontamination always wear protective gloves during the decontamination event.

Method A – Decontamination Using Control Water

Method B – Decontamination Using Detergent and Control Water

Method C – Decontamination Using an Organic Desorbing Agent

Method D – Decontamination Using an Inorganic Desorbing Agent

## Method A
## Decontamination Using Control Water

### 7. Significance and Use

7.1 This decontamination method is considered to be the minimum amount of decontamination that must be used to clean equipment. Its use is limited to those cases where the sampling equipment has only contacted relatively uncontaminated materials and there is little chance of contact with organic substances.

### 8. Apparatus

8.1 Control water. This is defined as water having a known chemistry. Deionized or distilled water is sufficient.

8.2 Wash bottle or pressure sprayer to dispense the control water.

8.3 Kimwipes or other lint-free tissues.

8.4 Brushes and scrapers made of inert material.

### 9. Procedure

9.1 Remove any solid material from the equipment by scraping or brushing with implements made of inert material.

9.2 Thoroughly rinse the piece of equipment with control water using a pressure sprayer or pressure from a wash bottle.

9.3 For equipment such as tubing and pumps that cannot be easily dismantled for cleaning with a pressure sprayer or wash bottle, circulate control water through the equipment.

9.4 Dry the equipment with Kimwipes or other lint-free tissues.

9.5 Store equipment in a manner that will minimize it from possible contamination by surface and atmospheric contaminants.

## 10. Comments

10.1 This method represents the minimum amount of decontamination that should be performed. Cross contamination of samples is possible if organic or other substances are not removed physically or by the control water.

### Method B
### Decontamination Using Detergent and Control Water

## 11. Significance and Use

11.1 This decontamination method is used when the material being sampled is not easily removed or tends to adsorb onto the equipment. This method employs a mild detergent wash that can chemically remove contaminants that are not removed by Method A.

## 12. Apparatus

12.1 Control water. Control water is defined as water of a known chemistry. Distilled or deionized water is adequate.

12.2 Pressure sprayer or wash bottle.

12.3 Kimwipes or other lint-free tissue.

12.4 Brushes and scrapers made of inert materials.

12.5 Detergent. This detergent should be phosphate-free, biodegradable, and soluble in hot or cold water. Isoclean, Alquinox, or Liquinox are acceptable.

## 13. Procedure

13.1 Remove any solid material from the equipment by scraping or brushing with implements made of inert material.

13.2 Wash and scrub the equipment thoroughly with the detergent solution using a brush.

13.3 Rinse the equipment thoroughly using control water.

13.4 Circulate the detergent solution through the equipment, followed by circulation of the control rinse, for equipment like tubing and pumps that cannot be easily dismantled for cleaning with a pressure sprayer or wash bottle.

13.5 Dry the equipment with Kimwipes or other lint-free tissues.

13.6 Store equipment in a manner that will minimize possible contamination by surface and atmospheric contaminants.

## 14. Comments

14.1 This method has less potential for cross contamination of samples than Method A but may not be adequate to decontaminate equipment that is grossly contaminated. Methods C and D should be added as necessary.

### Method C
### Decontamination Using an Organic Desorbing Agent

## 15. Significance and Use

15.1 This decontamination method should be used in cases when organic contamination of the sampling equipment has occurred or is suspected and when Method A or Method B is not sufficient to clean the equipment.

15.2 The choice of organic desorbing agent will depend on the kind of organic contaminant present and the analytical requirements of the sample being collected. Generally, a pesticide grade of methanol is recommended (methanol does not interfere with gas chromatography/mass spectroscopy [GC/MS] analysis); however, stronger desorbing agents like acetone or hexane may be required for proper decontamination.

## 16. Apparatus

16.1 Control water. Control water is defined as water of a known chemistry. Distilled or deionized water is adequate.

16.2 Pressure sprayers or wash bottles.

16.3 Brushes and scrapers made of inert material.

16.4 Organic desorbing agent, such as methanol, acetone, or hexane.

16.5 Kimwipes or other lint-free tissues.

## 17. Procedure

17.1 Clean any surface particles or film from the equipment with a scraper or brush made of inert material.

17.2 Wash with control water using a pressure sprayer or wash bottle.

17.3 Wash with the organic desorbing agent using a pressure sprayer or wash bottle. Protect skin from contact with organic agents.

17.4 Rinse with control water.

17.5 Dry with Kimwipes or other lint-free tissues.

17.6 Circulate decontamination liquids through equipment in the order listed above for equipment like tubing or pumps that cannot be easily dismantled for cleaning.

## 18. Comments

18.1 This method has less potential for cross contamination of samples with site contaminants than Method A or Method B but has a risk of contaminating the sample with organic desorbing agents.

### Method D
### Decontamination Using an Inorganic Desorbing Agent

## 19. Significance and Use

19.1 This method should be used to remove inorganic substances that have adsorbed onto sampling equipment and when Methods A and B are not sufficient to remove the substances.

## 20. Apparatus

20.1 Control water. Control water is defined as water with a known chemistry. Distilled or deionized water is acceptable.

20.2 Brushes or scrapers made of inert material.

20.3 Pressure sprayers or wash bottles.

20.4 Inorganic desorbing agent. An inorganic desorbing agent may be 10 percent nitric acid or 10 percent hydrochloric acid made from reagent-grade stock and deionized or distilled water. Other acids or combinations of acids prepared in a similar fashion may be appropriate.

## 21. Procedure

21.1 Remove any solid material from the equipment by scraping or brushing with inert tools.

21.2 Wash the equipment thoroughly with control water using a pressure sprayer or wash bottle.

21.3 Wash the equipment with an inorganic desorbing agent using a pressure sprayer or wash bottle. Protect skin from contact with inorganic desorbing agents.

21.4 Thoroughly rinse equipment with control water.

21.5 Dry equipment with Kimwipes or other lint-free tissues.

21.6 Circulate decontamination liquids through equipment in the order listed above for equipment such as tubing and pumps that cannot be easily dismantled for cleaning.

## 22. Comments

22.1 This decontamination method has the least potential for cross contamination of a sample with inorganic elements from the site but has a potential for contaminating the sample with inorganic desorbing agents. Additionally, strong desorbing agents such as the acids used in this method may dissolve or leach elements or compounds from the next sample, and great care must be taken to remove all acidic residues from the sampling equipment.

## 23. Quality Assurance

23.1 The following information should be recorded in the field logs or notebooks concerning decontamination of equipment:

23.1.1 Person responsible for performing the decontamination.

23.1.2 Method or methods used.

23.1.3 Control water used.

23.1.4 Type and quality of the organic and/or inorganic desorbing agent(s) used.

23.1.5 Location where decontamination was performed.

23.1.6 Other information as necessary: e.g., record of rinse or wipe samples before initial equipment decontamination and prior to its use for sampling to establish a baseline level of contaminant on the equipment, and record of final rinse or wipe samples after equipment has been decontaminated.

## 24. Heavy Equipment

24.1 Because heavy equipment is difficult to decontaminate, cover equipment with disposable covers or wraps to avoid contamination. However, decontamination will be unavoidable in many cases. Bulldozers, trucks, backhoes, drill rigs, drilling tools, and other heavy equipment are usually decontaminated by steam cleaning or high-pressure washes with water and/or detergent solutions. The decontamination method that will be used is a function of the degree and nature of the contaminant and the degree of decontamination that must be achieved. Generally, wet contamination will be kept wet and dry contamination will be kept dry. Wetting some compounds may cause chemical reactions that will react with equipment and produce undesirable substances that are more difficult to remove. The following general steps may be used for decontaminating heavy equipment:

24.1.1 Physically remove any bulk material adhering to the contaminated item by use of a wire brush or stiff bristle brush or scraper. Dry cleaning can be further accomplished using vacuum cleaners or sand blasting. For wet cleaning, use water or nonphosphate detergent (under pressure if necessary) to assist in the final removal of materials.

24.1.2 Steam clean the item.

24.1.3 Use a pesticide-grade methanol rinse if contamination is persistent.

24.1.4 Rinse with control water. Control water is defined as either deionized or distilled water.

24.1.5 Collect a wipe sample for analysis.

24.1.6 Repeat 24.1.1–24.1.4 as necessary if item is found or thought to be still contaminated.

24.2 Conduct decontamination procedures in an area where contaminated materials can be contained, such as a wash pad. Cleaning and rinsing solutions may be recycled or trapped as necessary. It is important to control the volume of decontamination solutions when expensive measures must be used for their disposal.

24.3 All portions of the equipment, including the undercarriage, chassis, and cab, must be decontaminated. Air filters should be checked and will often be contaminated if dusty conditions are encountered. A thorough visual inspection of equipment supplemented by wipes, as appropriate, will be used to determine the best method for decontamination and the decision to use higher levels of decontamination.

## 25. Keywords

25.1 Contaminant, contaminate, contamination, decontaminate, decontamination, equipment, inorganic, organic, sampling, and waste.

# Standard Practice for Soil Investigation and Sampling by Auger Borings[1]

This standard is issued under the fixed designation D 1452; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This practice covers equipment and procedures for the use of earth augers in shallow geotechnical exploration. This practice does not apply to sectional continuous flight augers.

## 2. Significance and Use

2.1 Auger borings often provide the simplest method of soil investigation and sampling. They may be used for any purpose where disturbed samples can be used and are valuable in connection with ground water level determination and indication of changes in strata and advancement of hole for spoon and tube sampling. Equipment required is simple and readily available. Depths of auger investigations are, however, limited by ground water conditions, soil characteristics, and the equipment used.

## 3. Apparatus

3.1 *Hand-Operated Augers*:

3.1.1 *Helical Augers*—Small lightweight augers generally available in sizes from 1 through 3 in. (25.4 through 76.2 mm).

3.1.1.1 *Spiral-Type Auger*, consisting of a flat thin metal strip, machine twisted to a spiral configuration of uniform pitch; having at one end, a sharpened or hardened point, with a means of attaching a shaft or extension at the opposite end.

3.1.1.2 *Ship-Type Auger*—Similar to a carpenter's wood bit. It is generally forged from steel and machined to the desired size and configuration. It is normally provided with sharpened and hardened nibs at the point end and with an integral shaft extending through its length for attachment of a handle or extension at the opposite end.

3.1.2 *Open Tubular Augers*, ranging in size from 1.5 through 8 in. (38.1 through 203.2 mm) and having the common characteristic of appearing essentially tubular when viewed from the digging end.

3.1.2.1 *Orchard-Barrel Type*, consisting essentially of a tube having cutting lips or nibs hardened and sharpened to penetrate the formation on one end and an adaptor fitting for an extension or handle on the opposite end.

3.1.2.2 *Open-Spiral Type*, consisting of a flat thin metal strip that has been helically wound around a circular mandrel to form a spiral in which the flat faces of the strip are parallel to the axis of the augered hole. The lower helix edges are hard-faced to improve wear characteristics. The opposite end is fitted with an adaptor for extension.

3.1.2.3 *Closed-Spiral Type*—Nearly identical to the open-spiral type except, the pitch of the helically wound spiral is much less than that of the open-spiral type.

3.1.3 *Post-Hole Augers*, generally 2 through 8 in. (50.8 through 203.2 mm), and having in common a means of blocking the escape of soil from the auger.

3.1.3.1 *Clam-Shell Type*, consisting of two halves, hinged to allow opening and closing for alternately digging and retrieving. It is not usable deeper than about 3.5 ft (1.07 m).

3.1.3.2 *Iwan Type*, consisting of two tubular steel segments, connected at the top to a common member to form a nearly complete tube, but with diametrically opposed openings. It is connected at the bottom by two radial blades pitched to serve as cutters which also block the escape of contained soil. Attachment of handle or extension is at the top connector.

3.2 *Machine-Operated Augers*:

3.2.1 *Helical Augers*, generally 8 through 48 in. (203.2 through 1219 mm), consisting essentially of a center shaft fitted with a shank or socket for application of power, and having one to three complete 360° (6.28-rad) spirals for conveyance and storage of cut soil. Cutter bits and pilot bits are available in moderate and hard formation types and normally replaceable in the field. They are normally operated by heavy-duty, high-torque machines, designed for heavy construction work.

3.2.2 *Stinger Augers*, generally 6 through 30 in. (152.4 through 762 mm), are similar to the helical auger in 3.2.1, but lighter and generally smaller. They are commonly operated by light-duty machines for post and power pole holes.

3.2.3 *Disk Augers*, generally 10 through 30 in. (254 through 762 mm), consisting essentially of a flat, steel disk with diametrically opposed segments removed and having a shank or socket located centrally for application of power. Replaceable cutter bits, located downward from the leading edges of the remaining disk, dig and load soil that is held on the disk by valves or shutters hinged at the disk in order to close the removed segments. The disk auger is specifically designed to be operated by machines having limited vertical clearance between spindle and ground surface.

3.2.4 *Bucket Auger*, generally 12 through 48 in. (304.8 through 1219 mm), consisting essentially of a disk auger, without shank or socket, but hinge-mounted to the bottom of a steel tube or bucket of approximately the same diameter as the disk auger. A socket or shank for power application is

[1] This practice is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D 18.02 on Sampling and Related Field Testing for Soil Investigations.

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located in the top center of the bucket diametral cross piece provided for the purpose.

3.3 *Casing* (when needed), consisting of pipe of slightly larger diameter than the auger used.

3.4 *Accessory Equipment*—Labels, field log sheets, sample jars, sealing wax, sample bags, and other necessary tools and supplies.

## 4. Procedure

4.1 Make the auger boring by rotating and advancing the desired distance into the soil. Withdraw the auger from the hole and remove the soil for examination and test. Return the empty auger to the hole and repeat the procedure. Continue the sequence until the required depth is reached.

4.2 Casing is required in unstable soil in which the bore hole fails to stay open and especially when the boring is extended below the ground-water level. The inside diameter of the casing must be slightly larger than the diameter of the auger used. The casing shall be driven to a depth not greater than the top of the next sample and shall be cleaned out by means of the auger. The auger can then be inserted into the bore hole and turned below the bottom of the casing to obtain a sample.

4.3 The soil auger can be used both for boring the hole and for bringing up disturbed samples of the soil encountered. The structure of a cohesive soil is completely destroyed and the moisture may be changed by the auger. Seal all samples in a jar or other airtight container and label appropriately. If more than one type of soil is picked up in the sample, prepare a separate container for each type of soil.

4.4 *Field Observations*—Record complete ground water information in the field logs. Where casing is used, measure ground water levels, both before and after the casing is pulled. In sands, determine the water level at least 30 min after the boring is completed; in silts, at least 24 h. In clays, no accurate water level determination is possible unless pervious seams are present. As a precaution, however, water levels in clays shall be taken after at least 24 h.

## 5. Report

5.1 The data obtained in boring shall be recorded in the field logs and shall include the following:

5.1.1 Date of start and completion of boring,

5.1.2 Identifying number of boring,

5.1.3 Reference datum including direction and distance of boring relative to reference line of project or other suitable reference points,

5.1.4 Type and size of auger used in boring,

5.1.5 Depth of changes in strata,

5.1.6 Description of soil in each major stratum,

5.1.7 Ground water elevation and location of seepage zones, when found, and

5.1.8 Condition of augered hole upon removal of auger, that is, whether the hole remains open or the sides cave, when such can be observed.

Technical Comments on ASTM Procedure D 1452–80

# Standard Practice for Soil Investigation and Sampling of Auger Borings

## Summary of ASTM D 1452–80

The purpose of this practice is to define equipment and procedures for shallow soil investigation and sampling with augers.

## Additions Applicable to Geotech and Its Subcontractors

This addendum addresses health and safety hazards that may be associated with the use of this procedure. The project supervisor shall perform a job-safety analysis prior to any sampling efforts to determine potential health and safety hazards that may be encountered. The project supervisor shall also conduct periodic job-safety analyses to ensure that all work is being performed safely and in accordance with established procedures. An identified hazard shall cause all work to be suspended until that hazard is eliminated or reduced to the lowest safe working level as reasonably possible.

The following sections shall be interpreted in conjunction with the current published version of the ASTM practice. The sections shall be interpreted in numerical order, using the published version as the base document for reference.

## 6. Referenced Documents

6.1 Geotech, *Environmental Procedures Catalog* (Manual 116):

Standard Practice for Equipment Decontamination [GN-13(P)].

Standard Practice for Utility Line Investigation [GP-4(P)].

6.2 Geotech, *Health and Safety Manual* (Manual 103).

## 7. Hazard Analysis

7.1 The use of this procedure may produce certain health and safety hazards that should be considered and reduced to the lowest risk level as reasonably possible. Some of the hazards that may be encountered are:

7.1.1 *Electrical sources*—All sampling sites will be surveyed for underground utilities as well as overhead power lines or other potential electrical sources according to Standard Practice for Utility Line Investigation [GP-4(P)].

7.1.2 *Motion sources*—This procedure applies to shallow auger boring sampling by hand or small hand-operated, engine-driven auger drills and does not apply to sectional continuous flight augers. Small portable-engine driven auger drills can cause injury to the operator(s) by entanglement of loose clothing, exhaust burns, muscle strains, and other related injuries. Sampling personnel should always exercise caution and maintain a safe distance from such potential hazard(s). Improper handling of sampling equipment can result in pinches, cuts, and other extremity injuries.

7.1.3 *Lifting sources*—Manual handling of samplers and other equipment is often necessary in the performance of the sampling tasks. Therefore, sampling personnel should adhere to proper techniques when lifting and carrying heavy sampling equipment or loads. Manual hand-sampling and hand-held, engine-driven auger drills require considerable physical effort of the sampling personnel. Each person assigned to take manual samples shall be aware of the hazards associated with such activity. Risks could include back strain or injury, muscle exertion, heat stress, and other such hazards associated with manual labor. A minimum two-member sampling team shall perform all sampling efforts when hand-held, engine-driven auger drills are used.

7.1.4 Pressure sources—Underground pressure sources may be encountered, such as water, gas, sewer, or other buried utilities. All utilities shall be surveyed, as described in Standard Practice for Utility Line Investigation [GP-4(P)], prior to any augering or sampling efforts.

7.1.5 *Chemical and radioactive sources*—The use of any subsurface sampling apparatus has the potential of penetrating unknown, extremely hazardous subsurface materials. These hazards may include materials that are corrosive, flammable, toxic, radioactive, or carcinogenic. In all cases, a thorough review of possible hazard factors will be made prior to sampling activities. All Geotech personnel shall adhere to the Geotech Health and Safety procedures, which will include the use of proper personal protective clothing and equipment and compliance with any mandatory site-specific requirements. All sampling equipment will be thoroughly decontaminated according to Standard Practice for Equipment Decontamination [GN–13(P)] and other mandatory site-specific decontamination requirements.

## 8. Keywords

8.1 Auger, soil investigation, and soil sampling.

# Standard Practice for the Sampling of Liquids

## Introduction

The type of sampling equipment shall depend on the sample to be collected, which analytes the sample is being collected for, and the site-specific requirements such as depth to water or depth of well. Because each sampling situation is unique, the equipment used and its application may have to be modified to ensure that a representative sample is collected and its physical and chemical integrity is maintained.

## 1. Scope

1.1 The procedures listed here are used to collect liquid samples. There are eight methods that can be used to collect liquid samples. Some sampling situations use a combination of these methods. For example, a peristaltic pump could be used to collect the inorganic samples and a bailer used to collect the organic samples. The eight methods are

| | Section |
|---|---|
| Method A—Sampling With a Peristaltic Pump | 5–7 |
| Method B—Sampling With a Bladder Pump | 8–10 |
| Method C—Sampling With a Bailer | 11–13 |
| Method D—Sampling With a Submersible Pump | 14–16 |
| Method E—Sampling With a Composite Liquid Waste Sampler (Coliwasa) | 17–19 |
| Method F—Sampling With a Dip-Type Sampler | 20–22 |
| Method G—Sampling by Container Immersion | 23–25 |
| Method H—Sampling From Taps, Valves, or Faucets | 26–28 |

## 2. Hazard Analysis

2.1 These procedures use gasoline-powered electric generators, gasoline-powered air compressors, and battery-powered pumps and accessories. The following safety precautions shall be followed.

2.1.1 Air compressors that are belt driven shall have a belt guard in place.

2.1.2 Care shall be taken when connecting and disconnecting equipment powered by lead-acid batteries to avoid generating sparks that have the potential of creating an explosive hazard.

2.1.3 Gasoline is a Department of Transportation-regulated material; its hazard class is Flammable Liquid. Gasoline shall be stored in Factory Mutual-approved safety cans. Safety cans shall be well secured in the vehicle during transport. Gasoline-powered equipment shall be cool before filling, and care should be taken not to spill any gasoline.

2.1.4 Air compressors shall not be operated above rated capacities and shall be configured to avoid having any dead-end fittings above 20 pounds per square inch (psi).

2.1.5 Care shall be taken when lifting heavy equipment; proper lifting techniques shall be used.

2.1.6 Site-specific controls are available in the planning documents for a particular site.

## 3. Referenced Documents

3.1 American Society for Testing and Materials, *Standard Guide for Sampling Groundwater Monitoring Wells*, D4448–85a, 1986.

3.2 Geotech, *Environmental Procedures Catalog*, Manual 116:

Standard Practice for Sample Labeling [GN–8(P)].

Standard Practice for Equipment Decontamiantion [GN–13(P)].

General Considerations for the Sampling of Liquids [LQ–1(G)].

3.3 U.S. Department of Energy, The *Environmental Survey Manual*, Appendix E, Volume 4, DOE/EH–0053, 1987.

3.4 U.S. Environmental Protection Agency, *Handbook of Groundwater*, EPA/625/6–87/016, 1987.

3.5 U.S. Environmental Protection Agency, *Practical Guide for Groundwater Sampling*, EPA/600/2–85/104, 1985.

3.6 U.S. Environmental Protection Agency, *SW–846, Test Methods for Evaluating Solid Waste*, Volume 2, 1986.

## 4. Significance and Use

4.1 The usefulness and limitations for each of the first four sampling methods are listed in General Considerations for the Sampling of Liquids [LQ–1(G)], Table 1 through Table 5. Coliwasa samplers are useful to obtain representative samples of multiphase materials from drums or other containerized vessels. Limitations are their relative high costs and the difficulty of decontaminating the sampler. Dip samplers only collect grab samples with a limited vertical extent. The sampler must be aware of this limitation and also exclude surface debris or films from liquid surfaces if this is not desired. Contamination from plumbing is a primary concern when sampling taps, valves, or faucets.

### Method A
### Sampling With a Peristaltic Pump

## 5. Apparatus

5.1 Peristaltic-type pump.

5.2 Silicone, C-FLEX, or Norprene tubing for the pump head.

5.3 Silicone, Teflon, polyethylene, or vinyl tubing for placing in the liquid to be sampled (suction line).

5.4 Generator or other source of electricity.

## 6. Procedure

6.1 The following procedure supplements the instruction in the instrument-specific operating manual.

6.1.1 Place the suction line in the liquid to be sampled. If sampling a monitoring well, place the tubing inlet just above the screened interval.

6.1.2 Connect the suction line to the pump.

6.1.3 Turn on the pump and adjust the flow rate so sample turbulence is at a minimum. Allow several liters to flow and recheck stability parameters (i.e., pH, conductivity, and temperature).

6.1.4 Fill the necessary sample bottles by allowing the pump discharge to flow gently down the side of the bottle with minimal turbulence.

6.1.5 Label, preserve, and document the samples as required by Standard Practice for Sample Labeling [GN–8(P)].

6.1.6 Remove the tubing from the liquid and clean and decontaminate as required by Standard Practice for Decontamination [GN–13(P)].

## 7. Procedure Bias

7.1 Sampling organics using a peristaltic pump is not recommended. The suction lift action will strip volatiles and degas the sample. The silicone tubing tends to absorb some organics and slowly release them, contaminating subsequent samples.

### Method B
### Sampling With a Bladder Pump

## 8. Apparatus

8.1 Bladder-type pump.

8.2 Air compressor.

8.3 Teflon, polyethylene, or vinyl tubing for the air and sample line.

## 9. Procedure

9.1 The following procedure is supplemental to the instruction in the instrument-specific operating manual.

9.1.1 Lower the pump gently to a position just above the screened interval.

9.1.2 Connect the air line to the pump controller.

9.1.3 Initiate pumping and allow several liters of water to be pumped prior to sample collection (recheck stability parameters, i.e., pH, conductivity, and temperature).

9.1.4 Fill the necessary sample bottles by allowing the pump discharge to flow gently down the side of the bottle with minimal turbulence.

9.1.5 Label, preserve, and document the samples as required by Standard Practice for Sample Labeling [GN–8(P)].

9.1.6 Remove the pump from the well and clean and decontaminate as required by Standard Practice for Decontamination [GN–13(P)].

## 10. Procedure Bias

10.1 Bladder-type pumps constructed of stainless steel, Teflon, or both provide superior performance for most applications. The use of Teflon sample- and air-line tubing allows the bladder pump to be used for the collection of organics. The main disadvantage is the slow pumping rate, large consumption of compressed air, and difficulty in cleaning and decontaminating.

### Method C
### Sampling With a Bailer

## 11. Apparatus

11.1 Teflon or stainless steel bailer.

11.2 Teflon or stainless steel cable or line.

11.3 Bailer reel.

## 12. Procedure

12.1 Attach a properly cleaned bailer to the cable or line.

12.2 Lower the bailer slowly until it contacts the liquid.

12.3 Allow the bailer to sink until it reaches the screened interval of the well or the desired sampling point.

12.4 Slowly raise the bailer to the surface.

12.5 Tip the bailer or use a bottom-emptying device and fill a container to recheck the stability parameters (i.e., pH, conductivity, and temperature).

12.6 Repeat steps 12.2 through 12.5 as many times as necessary to fill the sample bottles.

12.7 Label, preserve, and document the samples as required by Standard Practice for Sample Labeling [GN–8(P)].

12.8 Clean and decontaminate the bailer as required by Standard Practice for Decontamination [GN–13(P)].

## 13. Procedure Bias

13.1 Bailers constructed of Teflon, stainless steel, or both provide adequate performance for most applications. Bailers expose part of the sample to the atmosphere during sample withdrawal and should not be used to collect samples where contact with the atmosphere is important (i.e., field measurement of dissolved oxygen and Eh). A bottom-emptying device is recommended for the collection of volatile organics using a bailer.

### Method D
### Sampling With a Submersible Pump

## 14. Apparatus

14.1 Submersible-type pump.

14.2 Discharge tubing of vinyl, polyethylene, or Teflon.

14.3 Power source of generator or batteries.

## 15. Procedure

15.1 The following procedure is supplemental to the instructions provided in the instrument-specific operating manual.

15.1.1 Set up the pump according to the operating manual.

15.1.2 Gently lower the pump to a position just above the screened interval.

15.1.3 Initiate pumping and allow several tubing volumes of liquid to be pumped prior to sample collection. Recheck stability parameters, (i.e., pH, conductivity, and temperature).

15.1.4 Fill the necessary sample bottles by allowing the pump discharge to flow gently down the side of the bottle with minimal turbulence.

15.1.5 Label, preserve, and document the samples as required by Standard Practice for Sample Labeling [GN–8(P)].

15.1.6 Remove the pump and clean and decontaminate as required by Standard Practice for Decontamination [GN–13(P)].

## 16. Procedure Bias

16.1 Considerable sample agitation results when using a submersible pump. Submersible pumps are not recommended for the collection of dissolved gases, organics, or oxidation/reduction-sensitive samples. They also have a higher potential of sample contamination because of the construction material.

## Method E
## Sampling With a Coliwasa Sampler

### 17. Apparatus

17.1 Coliwasa-type sampler constructed of stainless steel, Teflon, polyethylene, or glass.

17.2 Teflon, stainless steel, or nylon suspension line.

17.3 Disposable gloves.

17.4 Kimwipes or equivalent lint-free tissue.

### 18. Procedure

18.1 Slowly lower the sampler into the liquid to be sampled. Lower the sampler at a rate that permits the levels of liquid inside and outside the sample tube to be about the same.

18.2 When the sample interval has been reached, seat the bottom check valve.

18.3 Slowly withdraw the sampler with one hand while wiping the outside of the sampler using a disposable tissue.

18.4 Carefully discharge the sample into the sample container.

18.5 Repeat steps 18.1 through 18.4 as many times as necessary to fill all the sample bottles.

18.6 Label, preserve, and document the samples as required by Standard Practice for Sample Labeling [GN-8(P)].

18.7 Clean and decontaminate the sampler as required by Standard Practice for Decontamination [GN-13(P)].

### 19. Procedure Bias

19.1 The Coliwasa-type sampler is appropriate for collecting samples of containerized liquids. The material of construction should be considered for the particular type of liquid to be sampled. A Coliwasa sampler is also difficult to decontaminate adequately.

## Method F
## Sampling With a Dip-Type Sampler

### 20. Apparatus

20.1 Dip-type sampler constructed of Teflon, stainless steel, polyproplylene, or glass.

### 21. Procedure

21.1 Assemble the sampler.

21.2 Slowly submerge the sampler into the liquid to be sampled causing minimal surface disturbance.

21.3 Retrieve the sampler from the liquid causing minimal surface disturbance.

21.4 Slowly empty the sampler into the sample bottle allowing the sample to flow gently down the side of the bottle.

21.5 Repeat steps 21.2 through 21.4 as many times as necessary to fill all of the sample bottles.

21.6 Label, preserve, and document the samples as required by Standard Practice for Sample Labeling [GN-8(P)].

21.7 Clean and decontaminate the sampler as required by Standard Practice for Decontamination [GN-13(P)].

### 22. Procedure Bias

22.1 A dip-type sampler is appropriate for surface liquids such as ponds, open tanks, pits, lagoons, and sewers. It can only be used for a grab-type sample, and its material of construction shall be compatible with the liquid to be sampled and the analytes of interest.

## Method G
## Sampling by Container Immersion

### 23. Apparatus

23.1 Sample container.

23.2 Disposable gloves.

23.3 Distilled or deionized water in a squeeze bottle.

23.4 Kimwipes or equivalent lint-free tissue.

## 24. Procedure

24.1 After putting on the appropriate gloves, submerge the sample bottle below the liquid surface. If the liquid is flowing, point the bottle upstream.

24.2 Allow the container to fill to the desired volume.

24.3 Remove the container, cap and rinse the container's outside surface with clean water, and dry with a tissue.

24.4 Label, preserve and document the sample as required by Standard Practice for Sample Labeling [GN–8(P)].

## 25. Procedure Bias

25.1 The container-immersion method can only be used to collect samples from shallow streams, near the shore of ponds or lakes, or from open-top containerized liquids. It can only be used for a grab-type sample and requires immersing the hands; it is not acceptable for highly polluted or hazardous liquids.

### Method H
### Sampling From Taps, Valves, or Faucets

## 26. Apparatus

26.1 Distilled or deionized water in a squeeze bottle.

26.2 Kimwipes or equivalent lint-free tissue.

26.3 If the sample bottle cannot be placed under the tap, valve, or faucet, a hose or other device shall be attached to the outlet to allow the sample to be collected.

## 27. Procedure

27.1 Turn on the tap, valve, or faucet and allow sufficient liquid to flow to ensure that any rust or residue is removed from the lines and that fresh liquid is flowing.

27.2 Remove the cap from the sample container and place the container under the source.

27.3 Fill the sample bottle to the desired volume.

27.4 Repeat steps 27.2 and 27.3 as many times as necessary to fill all of the sample containers.

27.5 Shut off the tap, valve, or faucet; clean the outside of the sample container using clean water and wipe dry.

27.6 Label, preserve, and document the sample as required by Standard Practice for Sample Labeling [GN–8(P)].

## 28. Procedure Bias

28.1 This procedure is used to collect grab-type samples from piped systems. Strainers, aerators, and hose attachments should be removed prior to sample collection. The material of construction for the piping system influences sample impurities and should be documented in the field logbook.

## 29. Quality Assurance

29.1 All of the methods listed above require the following information to be logged for quality-assurance documentation.

29.1.1 Date of sample collection.

29.1.2 Location of sample.

29.1.3 Sample number.

29.1.4 Type of sampling mechanism used.

29.1.5 Container type, size, and number of samples collected.

29.1.6 Preservatives used.

29.1.7 Signature of sampler.

## 30. Keywords

30.1 Bailer, coliwasa, liquid samples, sampler, and sampling.

# Standard Practice for the Collection, Filtration, and Preservation of Liquid Samples

## Introduction

Many factors should be considered during the sample-collection phase. These factors include bottle type, bottle size, preservative, whether the sample should be filtered or not, in what order the samples should be collected, etc. The procedures listed here are general guidelines. Site-specific requirements vary and no one procedure will fit all situations. In many cases, the judgment of a well-trained, experienced team leader is required to make the necessary decisions in the field to obtain the best sample possible and meet all requirements.

### 1. Scope

1.1 This procedure covers the collection, filtration, and preservation of liquid samples. Section 6 gives the general collection procedures. Sections 7 and 8 are specific for the collection of organics. Section 9 provides the procedure for sample filtration. Section 10 provides procedures for sample preservation, and Table 1 summarizes the generally accepted bottle types, volume requirements, preservatives, and holding times for most analytes. Note that the analytical laboratory providing the analytical support in most cases will determine the bottle type, volume, and preservative needed for a particular sampling event.



### 2. Hazard Analysis

2.1 This procedure uses a variety of chemicals for preserving the samples. The sampler shall have a copy of and review the Material Safety Data Sheets (MSDSs) for each of the chemicals that will be used at a particular site. Most of the preservatives can be categorized as strong acids or strong bases. These are Department of Transportation (DOT)-regulated materials; their hazard class is Corrosive.

2.2 The personal protective measures for strong acids (hydrochloric acid, nitric acid, and sulfuric acid) are to avoid eye and skin contact, provide adequate ventilation, wear eye protection, and wear disposable gloves. Use baking soda to neutralize spills. First aid measures are to flush immediately with water for 15 minutes and contact a physician.

2.3 The personal protective measures for strong bases (such as sodium hydroxide) are to avoid eye and skin contact, provide adequate ventilation, wear eye protection, and wear disposable gloves. First aid measures are to flush immediately with water for 15 minutes and contact a physician.

2.4 Site-specific controls are available in the planning documents for a particular project.

### 3. Referenced Documents

3.1 American Public Health Association, American Water Works Association, and Water Pollution Control Federation, *Standard Methods for the Examination of Water and Wastewater: American Public Health Association*, Washington, D.C., 1980.

3.2 American Society for Testing and Materials, *Annual Book of ASTM Standards*, 1984, Section 11, Volume 11.01, 1984.

3.3 Geotech, *Environmental Procedures Catalog*, Manual 116:

Standard Practice for Sample Labeling [GN–8(P)].

3.4 Korte, N., and D. Ealey, *Procedures for Field Chemical Analyses of Water Samples*, Technical Measurements Center, U. S. Department of Energy, Grand Junction Area Office, GJ/TMC–07(83), 1983.

3.5 U.S. Department of Energy, *The Environmental Survey Manual*, Appendix E, Volume 4, DOE/EH–0053, 1987.

3.6 U.S. Environmental Protection Agency, *Practical Guide for Groundwater Sampling*, EPA/600/2–85/104, 1985.

3.7 U.S. Environmental Protection Agency, *SW–846, Test Methods for Evaluating Solid Waste, Vol. II, Field Manual, Physical/Chemical Methods*, Office of Solid Waste and Emergency Response, November 1986, Third Edition.

3.8 Wood, W.W., "Guidelines for Collection and Field Analysis of Ground-Water Samples for Selected Unstable Constituents," in *Techniques of Water-Resources Investigations of the United States Geological Survey*, Chapter D2, Book 1: U.S. Government Printing Office, Washington, D. C., Stock Number 024–001–02879–4, 1976.

## 4. Significance and Use

4.1 Table 1 lists many of the standard methods for sample preservation and bottles that may be required for sample collection. Improper filtration, preservation, or residence time before analysis may compromise sample integrity.

## 5. Apparatus

5.1 Sample bottles.

5.2 Sample labels.

5.3 Preservative solutions as required by the planning documents. These solutions are DOT-regulated materials; their hazard class is Corrosive.

5.4 Dispensers for preservative solutions.

5.5 Coolers and ice for storing collected samples at 4 °C.

5.6 In-line filter holders and filters of 0.45-micrometer (µ m) pore size.

## 6. General Sample Collection Procedures

6.1 All samples shall be collected as close to the source as possible. The order in which samples are taken for specific types of analyses is provided in Sections 6.3, 6.4, and 6.5.

6.1 Choose the appropriate bottles for the analytes needed (see Table 1). Visually inspect the bottle for cleanliness, breaks, and missing parts prior to sampling.

6.2 Label the bottles as required by the planning documents or Standard Practice for Sample Labeling [GN–8(P)].

6.3 Collect the samples by allowing the liquid to flow gently down the side of the bottle with minimal turbulence. Unfiltered samples shall be collected prior to filtered samples.

6.4 Unfiltered samples shall be collected in the following order:

6.4.1. Volatile organics and total organic halides (TOX).

6.4.2. Dissolved gases and total organic carbon (TOC).

6.4.3. Large-volume samples for organic compounds.

6.4.4. Sensitive inorganics, $NO_2-$, $NH_4+$, Fe(II), etc.

6.4.5. Total metals.

6.5 Filtered samples shall be collected in the following order:

6.5.1. Alkalinity.

6.5.2. Sensitive inorganics.

6.5.3. Trace metals.

6.5.4. Major cations/anions.

6.6. Add preservative as required.

6.7. Cap the bottle securely.

6.8. Store as required. Some samples may require storing at 4 °C immediately after collection. An ice chest with ice shall be used for storage.

## 7. Sampling for Non-Volatile Organics

7.1 Samples for non-volatile organics are collected directly into the sample container. The container shall be cleaned to U.S. Environmental Protection Agency (EPA) standards or purchased from a distributor that has cleaned them to EPA standards (i.e., I-CHEM). Do not filter samples for organics.

7.1.1 Choose the appropriate bottle for the analyte requested.

7.1.2 Label the bottle as required by the planning documents or Standard Practice for Sample Labeling [GN–8(P)].

7.1.3 Add preservative to the bottle, if required.

7.1.4 Slowly fill the bottle by allowing the liquid to flow gently down the side of the bottle with minimal turbulence.

7.1.5 Cap the bottle securely.

*Table 1. Guidelines for Preservation of Samples*

| Analytical Parameter | Container Type/Size[a] | Preservation |
|---|---|---|
| ***Inorganic Anions —*** | | |
| Chloride, sulfate, nitrate, fluoride, bromide, nitrite, and ortho-phosphate | P (500 mL) | Filtered 0.45 µ m, cool to 4 °C |
| Ammonia | P (125 mL) | Filtered 0.45 µ m, $H_2SO_4$ pH <2 |
| ***Inorganic Cations*** | | |
| Dissolved metals | P (500 mL) | Filtered 0.45 µ m, $HNO_3$ pH <2 |
| Total metals | P (500 mL) | $HNO_3$ pH <2 |
| ***Radioisotopes*** | | |
| U–234/U–238 | P (1,000 mL) | Filtered 0.45 µ m, HNO3 pH <2 |
| Th–230 | P (1,000 mL) | Filtered 0.45 µ m, HNO3 pH <2 |
| Po–210 | P (1,000 mL) | Filtered 0.45 µ m, HNO3 pH <2 |
| Pb–210 | P (1,000 mL) | Filtered 0.45 µ m, HNO3 pH <2 |
| Ra–226 | P (1,000 mL) | Filtered 0.45 µ m, HNO3 pH <2 |
| Ra–228 | P (3 each; 1,000 mL) | Filtered 0.45 µ m, HNO3 pH <2 |
| Gross alpha/beta | P (100 mL) | Filtered 0.45 µ m, HNO3 pH <2 |
| ***Organics*** | | |
| Volatile organics | G (2 each; 40 mL) | Cool to 4 °C |
| Semivolatile organics | G (1,000 mL) | Cool to 4 °C |
| Polychlorinated biphenyls and pesticides | G (1,000 mL) | Cool to 4 °C |
| Herbicides | G (1,000 mL) | Cool to 4 °C |
| Total organic halides (TOX) | G (1,000 mL) | Cool to 4 °C |
| Total organic carbon (TOC) | G (125 mL) | $H_2SO_4$ pH <2, cool to 4 °C |
| Phenols | G (1,000 mL) | $H_2SO_4$ pH <2, cool to 4 °C |
| Oil and grease | G (1,000 mL) | $H_2SO_4$ pH <2, cool to 4 °C |
| ***Other*** | | |
| Biochemical oxygen demand and chemical oxygen demand | G (1,000 mL) | Cool to 4 °C |
| Total dissolved solids | P (250 mL) | Filtered 0.45 µ m, cool to 4 °C |
| Cyanide | P (1,000 mL) | NaOH pH <2, cool to 4 °C |
| Sulfide | P (1,000 mL) | 2 mL zinc acetate, NaOH pH <2, cool to 4 °C |

[a]P = polyethylene; G = glass.

7.1.6 Store as required. Most organic samples require storage at 4 °C.

## 8. Sampling for Volatile Organics.

8.1 When sampling for volatile organics, special care shall be taken when collecting the sample to reduce the possibility of losing the volatile constituents. Volatile organics are collected in a 40-milliliter (mL) glass vial that has a Teflon-lined, silicone-septum lid. The procedure for collection is as follows:

8.1.1 Label the bottle.

8.1.2 Preserve as required.

8.1.3 Slowly fill the vial to overflowing.

8.1.4 Hold the container level or carefully set on a level surface.

8.1.5 Place the septum Teflon-side down on the convex water meniscus and seal with the screw cap.

8.1.6 Test the seal by inverting the container and lightly tapping. There can be no air bubbles entrapped in the sample. If bubbles are present, uncap the container, add additional sample, and reseal as stated above.

## 9. Sample Filtration Procedure

9.1 Samples requiring filtration shall be collected after unfiltered samples. To maintain closed-system conditions, an in-line membrane filter is connected directly to the pump outlet. This allows the sample to be filtered prior to atmospheric contact, which could alter the sample. A filter-pore size of 0.45 micrometers (μ m) is used for sample filtration.

9.1.1 Connect the in-line filter directly to the pump outlet.

9.1.2 Start the pump and discard the first 100 mL of sample. This flushes the filter of any excess distilled water used during prior cleaning of the filter holder.

9.1.3 Place the sample bottles directly under the filter outlet and fill to the desired volume.

9.1.4 Preserve the sample, as required.

9.1.5 Stop the pump, disconnect and disassemble the filter.

9.1.6 Discard the used filter and clean all surfaces of the filter holder with distilled water and wipe dry with a lint-free tissue.

9.1.8 Place a new filter in the holder and reassemble.

## 10. Sample Preservation Procedure

10.1 Samples are preserved by a variety of means to stabilize specific parameters so that the samples can be shipped to a laboratory for analysis. Preservatives are intended to (1) retard biological effects, (2) retard hydrolysis, (3) reduce sorption effects, and (4) reduce volatility of constituents. Preservation methods are generally limited to pH control, chemical addition, refrigeration, and protection from light. The following guidelines shall be considered during sample preservation.

10.1.1 Preservation of samples uses a variety of strong acids and bases. Care shall be taken in their storage and use. Review the Material Safety Data Sheet for each chemical. Eye protection and disposable gloves shall be worn when working with chemicals.

10.1.2 Samples shall be preserved as soon after collection as possible.

10.1.3 Care shall be taken not to cross contaminate samples with preservatives.

10.1.4 Samples requiring cooling to 4 °C shall be placed in an ice chest with wet ice immediately after collection.

10.1.5 Table 1 or the planning documents should be consulted for recommended sample-preservation techniques for each parameter. Generally, the laboratory performing the analysis shall determine the bottle type, size, and preservative to be used.

## 11. Quality Assurance

11.1 The following information about the sample collection, filtration, and preservation shall be logged for quality-assurance documentation.

11.1 The number and type of filter used for filtration.

11.2 The container size, container type, and number of samples collected.

11.3 Whether the sample was filtered or not.

11.4 What preservative was used to preserve the sample.

11.5 Name of person performing the sampling.

## 12. Keywords

12.1 Collection, filtration, liquid samples, and preservation.